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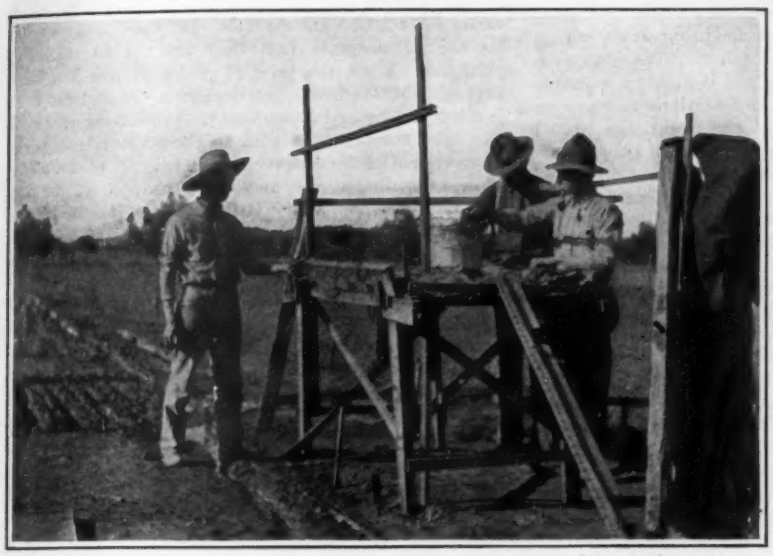


The "transplanting board" on which the trees are prepared for setting out

The lath house which gives the proper forest effect of sunlight and shade

Turning Sand Hills into Pine Forests

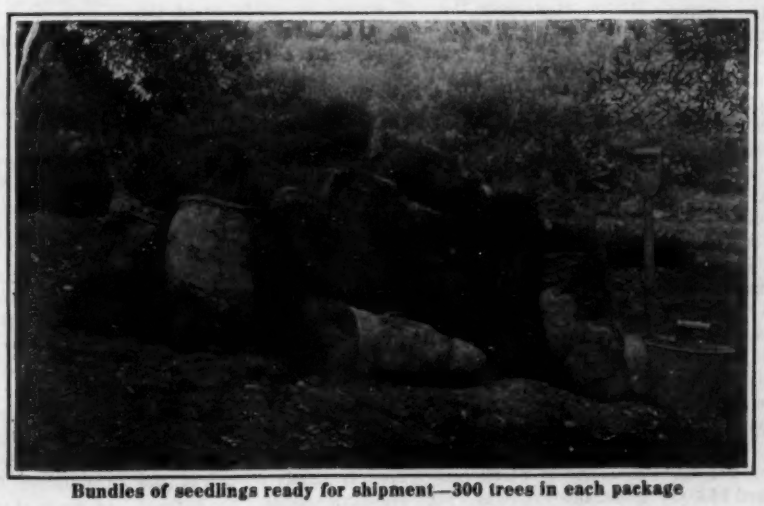
By R. P. Crawford

NEBRASKA probably has as little natural forest as any state in the union. One fourth of its entire area is composed of sand hills. These two apparently isolated facts give the background to one of the most important forestation projects of the present time—that of turning these sand hills into pine forests. After many years of experiment the United States forest service has developed sure methods whereby trees can be successfully grown in that locality, has planted an incipient forest of some 3,000 acres, and is now supplying trees to those who will plant them on their own property in the hills. Only a small part of the sand-hill district can be used for purely agricultural purposes with any degree of success. Consequently forestation is of importance in that a supply of timber will be secured in time, wind protection will be afforded, humus will be added to the barren soil and the farms to the east will be protected from the encroachment of the sand.

The novelty of the project itself, together with the nurseries for the special development of sand-hill trees, the establishment of camps in the hills where the planting operations are be carried on, the rapidity of the actual planting operations themselves—the system to it all—make the achievement unique. In 1902 two areas were set aside, comprising the Nebraska National Forest, the Bessey division of 92,000 acres near Halsey, 200 miles northwest of Lincoln, and the Niobrara division of 114,000 acres in the extreme northern part of the sand hills. At Halsey a nursery has been maintained for 12 years and another nursery has just been established on the Niobrara division and work is now being pushed in that locality.

At first broadcast sowing of seed was tried in the sand hills. It was unsuccessful, however, and now both jack pine and yellow pine, which have been found to be the best varieties, are grown from seed in the nursery and then are transplanted to the hills. Nearly six million seedlings were raised at the Bessey nursery last season. Seed beds are established each spring after the ground has been flooded. The beds are grouped in sections, 50 feet wide and 160 feet long and the sections are separated from one another by five-foot windbreak fences, calculated to check the west winds. The seed is sown broadcast in the nursery so as to make about 125 seedlings to the square foot. Soil is sifted over the beds and a light sprinkling follows. The beds are then covered with burlap, which is fastened down at the edges so as to be in close contact with the soil. This prevents drying of the surface and blowing out of the seed. Before germination takes place shade frames, easily rolled back in cloudy weather, are placed over the beds, thus allowing the plants only one-half of the full sunlight. The shade frames are used during practically all the first year. For two years the trees are kept in the same beds and then are transplanted to other beds in the nursery for another year's growth which allows for the development of a more compact root system.

Planting seedlings in the field



Bundles of seedlings ready for shipment—300 trees in each package

The actual planting operations in the hills are carried out during a month or six weeks' time in the spring. A temporary camp is established in the sand hills while the trees are being transferred from the nursery to their permanent locations. Wells have to be dug and a mess house erected for the men, as well as a barn accommodating some forty horses. The workmen, numbering about fifty, sleep in tents.

The trencher method of field planting has proved the most successful. It consists in turning back a shallow furrow with an ordinary breaking plow. A trencher, consisting of a V-shaped piece of iron attached to a plow beam, follows the plow and makes a slit in the middle of the furrow, in which the roots of the tiny trees are placed. The planter closes the slit with a thrust of his foot. A crew of six planters is able to set from 12,000 to 15,000 trees a day in this manner. From 1,500 to 1,800 trees are set to the acre.

It has been found that yellow pine is best adapted to the ridges, which have little vegetation and are exposed to winds. On the south slopes jack pine apparently forms the most desirable plantation, in the bottoms yellow pine, while on the north slopes either variety is successful. Not the least important part of the work is the free distribution of trees to ranchmen and other property owners in the sand hills, 131,200 trees being distributed in this manner during 1916. Prairie fires are the natural enemy of the small forest. The grassy vegetation of the hills would make it easy for them to get a start if constant care was not taken during the danger season. For safety all of the plantations are surrounded by double fire guards.

So far the poorest and roughest sections of the sand hills have been attacked by the foresters, those parts of the hills that never could be successfully farmed. In the driest season 50 to 60 per cent of the young trees will survive while under favorable conditions 90 per cent will live. Rough calculations indicate that tracts of sand hill land set out in forests, will, when the timber is sold at the end of 20 or 25 years, pay a profit of about $5 an acre per year, against a maximum of 50 cents when used for grazing.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Restriction of Efficiency by Order of Congress

WITH characteristic inconsistency, our Congress, having recently instituted a search for inefficiency in the construction of the emergency fleet, and about to search for inefficiency in the manufacture of airplanes and Browning guns, is, at the same time considering a proviso of the Naval Appropriation Bill which will prohibit the use of efficiency methods in work for the Navy, and will prevent the payment of bonuses to workers in Government factories. The situation would be amusing were it not so serious. That such a proviso should be considered for a moment is inconceivable; that it should actually have been adopted by the House passes understanding.

Who had the temerity to introduce this proviso into the Naval Appropriation Bill? How was it that Representatives from all parts of this land could have agreed to such a measure? Was it fear of the I. W. W.? Did they really fail to recognize the fine hand of the Hun in inserting this subtle clause which would hamper the work in our construction yards?

The only possible excuse for such a stupid bit of legislation is that of ignorance. Apparently Congressmen are not up-to-date. They are still imbued with the idea that efficiency is a scheme for robbing the American laborer of his liberty. They do not realize that the industrial engineer of today is a very different man from the blundering pioneers of yesterday. It is now well recognized that efficiency which does not concern itself with the welfare and interests of the workman is not efficiency. The industrial engineer of today is a coach, much like the coach of our athletic teams, whose duty it is to show men how to improve their work, with the result that the output is of superior quality and quantity; and in this superiority the workman himself shares.

We hear much these days of German efficiency without realizing that it was introduced into Germany from America, and there it found a fertile field. England, where opposition to efficiency was strenuous before the war, now recognizes that the study of improvement in manufacturing methods is absolutely essential to the winning of the war. We are engaged in a death struggle. We cannot for a moment countenance any measure which will hamper our output at this critical period. American laborers are beginning to understand the benefits of efficiency methods, and the purpose behind them. A campaign of education is being conducted among the workers in our shipyards, and they are coming to realize that their work is just as much a part of this war as that of their sons fighting in the trenches. It is high time that a similar campaign of education was instituted among Congressmen.

How the Airplane Appropriation Was Spent

THE figures presented to the House Military Affairs Committee by W. C. Potter, Chief of the Equipment Division of the Aviation Section of the United States Army show that, contrary to the statement that a billion dollars has been spent and we have nothing to show for it, there has actually been expended $307,000,000 for airplanes, training fields, etc., and that there is an unexpended balance now on hand of $433,000,000. This unexpended balance is covered by contract, and additional contracts have been let for machines and equipment which call for expenditures of $148,000,000 beyond the appropriation. The money already expended has been used as follows: For engines, airplanes and general machine equipment, $163,000,000; for hangars and for the acquirement of aviation fields in this country, $42,000,000; for aviation fields and other purposes in France, $31,000,000; and for gas balloons, $5,000,000. There is $31,000,000 in the hands of the Disbursing Agent, and not reported on at the hearing. The balance has been spent for miscellaneous aviation work, for experimental work, and other general expenses.

Liberty motors are now being made at the rate of one hundred a week; and the Government has ordered 14,000 foreign planes of which 1,800 have been delivered while 8,000 foreign engines have been contracted for, of which some 1,500 have been delivered.

Today there are about 1,300 aviators flying with the American forces on the western front; there are 5,000 men physically fit and ready to enter the service; and there are 15,000 flying and non-flying aviation service officers in the United States and France. Altogether, in the Signal Corps there are today 133,000 officers and men.

One hundred Liberty motors have been shipped to France, which has placed orders for 10,000 Liberty motors with this Government. In addition to the Liberty Motors, we are filling large orders for Bugatti and Hispano-Suizas. In the last year, 5,000 training planes were built in this country.

Trade with Germany After the War

THERE is a growing realization among us that we possess a most potent weapon against Germany in the commanding position we hold as a great industrial and commercial people and in our ability to wage an export war against that country. The suggestion has been made more then once, and in highly responsible quarters, that if Germany should continue to carry on her present brutal war against the world, the United States should confront her with the threat of an economic war after she has been defeated on the field of battle.

The subject has been given great prominence, and has received the very highest authority and sanction in recent action by the Chamber of Commerce of the United States of America, whose headquarters are in Washington, D. C. The Chamber of Commerce, Boston, Mass., presented for the consideration of the National Chamber through referendum vote of its members, the question of preventing excessive rearmament after the war, through discrimination against Germany in export trade, if this should be considered to be necessary for self-defense. This was presented in the following preambles and resolution:

WHEREAS, The size of Germany's present armament and her militaristic attitude have been due to the fact that her government is a military autocracy, not responsible to the German people; and,

WHEREAS, The size of the German armament after the war will be the measure of the greatness of the armament forced on all nations; and,

WHEREAS, Careful analysis of economic conditions shows that the size of Germany's future armament will fundamentally depend on her after-war receipts of raw materials and profit from her foreign trade; and,

WHEREAS, In our opinion the American people for the purpose of preventing an excessive armament will assuredly enter an economic combination against Germany, if governmental conditions in Germany make it necessary for self-defense; and

WHEREAS, We believe the American people will not join in discrimination against German goods after the war if the danger of excessive armament has been removed by the fact that the German government has in reality become a responsible instrument, controlled by the German people; therefore, be it

RESOLVED, That the Chamber of Commerce of the United States of America earnestly calls the attention of the business men of Germany to these conditions and urges them also to study this situation and to coöperate, to the end that a disastrous economic war may be averted and that a lasting peace may be made more certain.

The vote throughout the country closed on February 26th, 1918, when 535 organizations, situated in 46 states, and in the District of Columbia and in Alaska, had filed ballots. The count showed that 1,204 were in favor and only 151 against the resolution.

The Chamber of Commerce of the United States of America is committed to the question if more than one-third of the voting strength of the Chamber is recorded and if more than two-thirds of the votes thus cast, representing more than 20 states, are in favor of the proposition. Since this proportion was exceeded and it was found that 1,204 votes were in favor of an economic war as against 151 opposed, the Chamber of Commerce of the United States of America is committed to the endorsement of this momentous resolution.

The Truth About Platinum

WE have within the past two months received a quantity of circular mail from an association of manufacturing jewelers, the general content of which has been a consistent minimizing of the platinum shortage and a persistent decrying of the suggestion that while the war lasts jewelry of this metal is out of order. We have taken the trouble to look into the facts so far as we are able to do so; and as a result we arise to brand this propaganda as a most vicious one, conceived and carried out from motives wholly selfish and unworthy of American business men.

There is not the slightest question that there is a shortage of platinum. There is barely enough of the metal in sight to meet the urgent demands of the current year, and production is practically at a zero point. Importation from Russia, always the center of the world's supply, has of course ceased; and the United States and the Colombian Republic are the only remaining sources of a supply that is wholly inadequate to the needs of the civilized portion of the world. Unless platinum now in the hands of the jewelers is commandeered to meet the nation's requirements, as has been done both in England and in Germany, it is difficult to see where the immediate war needs are to be filled.

Platinum is essential for many war industries, especially the manufacture of sulfuric acid and the oxidation of ammonia to nitric acid. The scarcity of the metal throughout the world and its consequent high price are apparently due almost *in toto* to the fact that the women of this and other countries have recently been led to consider it a choice article for personal adornment. We believe this to be due to an entirely false conception; there are other white metals equally available for the setting of gems and the manufacture of jewelry, which would in fact be used for those purposes today except for the circumstance that they are not so costly as platinum. When the price of platinum was less than that of gold, there was practically no demand for it in jewelry proper, and little more in the setting of gems. But since the price has gone to the present level, over fifty per cent of the country's annual supply of the metal is used for the wholly unessential purpose of making jewelry. Yet no jewelry is more easily imitated than that made of platinum, and much white metal jewelry is now on the market which can be distinguished from platinum only by an expert.

It is inconceivable that any person would wear a lead-colored ring or bracelet or other ornament, except because of the false value which its artificially produced high price gives it in his eyes. In doubtful taste at any time, surely now, when our basic war needs for platinum are to be met only with the greatest difficulty, the purchasing of jewelry made from this unattractive metal cannot be considered as anything other than the height of unpatriotism. It is surpassed, in its class, by but one act—that of deliberately, and for the sake of profit, urging those ignorant of the true state of affairs to buy such jewelry.

British Women in the War

THE vast scale, both of the expenditure and supply of munitions during the recent battle in Picardy, was revealed in the House of Commons when the Minister of Munitions presented his estimates.

As regards the losses of artillery, the Minister stated that the total number of guns destroyed by shell-fire and captured amounted to nearly 1,000; that between 4,000 and 5,000 machine guns had been either destroyed or lost, and that the quantity of ammunition accounted for amounted to between one and three weeks' total of manufacture. Nevertheless, by April 20th, or a little over one month from the start of the great German offensive, all the losses had been made good.

The Minister announced that although, during the retreat, vast quantities of small arm ammunition were lost or left behind, the expenditure did not exceed the maximum potential capacity of the British factories and that the demand was met without touching the enormous reserves which had been accumulated against such a contingency. Although the wastage of rifles was very great the losses were promptly made good.

As showing the great capacity of the munition factories, the Minister stated that the preparations for the German offensive had contemplated a period of supreme battle intensity starting in the third week of February instead of from the third week of March. So that, at the date of his statement, April 25th, the munition supply was from one to three weeks to the good.

The calculations for 1918 allowed the artillery to fire during the whole fighting season a considerably heavier volume of shells than was expended weekly during the offensive battles of last year, and more than double the volume of shells fired during the terrific bombardment which characterized the Somme offensive of 1916.

As reported in dispatches to the New York *Times*, the Minister said: "Barring unforeseen circumstances, our supply of munitions would enable us to carry on a battle at the supreme pitch of intensity until winter without compromising our requirements for 1919."

The progress in British airplane production was shown by comparison with other years. Thus, at the present time, the airplane factories are turning out in a single week more airplanes than were made in the whole of 1914, in a single month more than were made in the whole of 1915, and in three months of the present year more planes are being delivered than were made in the whole of 1916. Furthermore, the factories will turn out in 1918 several times the output of 1917. We have all known that women are doing great work during the present war, even in the domain of manual labor; but we were scarcely prepared for the astonishing statement, that more than nine-tenths of this huge output of shells, sufficient, be it remembered, for a continuous battle throughout the whole of the summer, is due to the labors of more than three-quarters of a million women, who, before the war, had never seen a lathe.

Aeronautical

Ash Trees for Airplanes.—The appeal of the Aerial League of the British Empire to landowners to offer their ash trees for aeronautical purposes, has resulted in between three and four thousand trees being offered within the last few weeks, according to *Flight*. The government requirements in the next twelve months are expected to exceed 200,000 trees.

Monoplanes and Triplanes.—For the last two years of war the biplane type has been in practically universal use, although during the last year the British have employed a few squadrons of Sopwith triplanes with excellent results. However, at present there are many indications that designers are again swinging back to the monoplane in search of greater speed, better climbing ability, and greater maneuvering power. In a recent British official statement it is admitted that excellent results are being obtained at the front with a new monoplane. On the other hand, the Germans are now trying their hand at triplanes, and it is reported that they are rapidly increasing the number of this type flying at the front.

Aeronautical Engines at High Altitudes.—In coöperation with the subcommittee on power plants of the National Advisory Committee for Aeronautics, the Bureau of Standards has built a laboratory for the testing of aeronautic engines under conditions of reduced atmospheric pressure, in order to determine, among other things, the effect of different grades of fuel with respect to the variations in atmospheric pressure encountered in flying. It is thought possible that for high altitude service considerable improvement in power, climbing ability and speed might be obtained by the use of special fuels. At the same laboratory tests will be made of other methods and appliances, such as carburetion accessories, which have been proposed for increasing the output of power at great altitudes.

Shooting Through the Propeller Hub.—In battleplane design the placing of the machine gun is one of the leading problems. Quite naturally, too, for the mission of a battleplane is to fight the enemy, and the means of attack are a paramount consideration in consequence. So the invention of A. J. Reynolds of Dublin, Ireland, is of particular interest at present, since it deals with the firing of a machine gun through the propeller hub of a battleplane. Mr. Reynolds suggests the use of a propeller mounted on a hollow shaft through which the gun fires, and a gear transmission between engine and shaft. Furthermore, in the event that the gun muzzle does not extend out beyond the propeller, he suggests a spiral or screw in the gun tunnel in order to suck out the powder gases. The scheme is good, although not altogether new. Already the Hispano-Suiza engine has been arranged with a Lewis gun firing through the hollow shaft of a propeller, geared to the engine.

New Yorkers Insured Against Air Raids.—The big gas and electric lighting companies of New York city have arranged for insurance in excess of $50,000,000, covering bombardment from the air or the sea and other forms of war risk. According to the *Aerial Age Weekly*, $40,000,000 worth of the total insurance has been taken by the Consolidated Gas Company, whose plant comprises one of the most valuable properties in the city. From $7,000,000 to $10,000,000 has been taken by the New York Edison Company. Three million is said to have been taken by the United Electric Light and Power Company, although the correctness of this sum has not been confirmed. In their decision to insure against loss from enemy attack, the big lighting companies have followed the example of a number of other large concerns who, since the outbreak of the war have insured themselves against invasion to an extent estimated by Howard P. Moore, assistant secretary of a large insurance company, at close to $200,000,000.

Manufacture of Rubber Balloons for Wind Observation.—The Royal Netherlands Meteorological Institute at De Bilt, near Utrecht, with branches elsewhere in Holland, until 1916 used for wind observations in the upper air small caoutchouc balloons which were obtained from France. Then information came from Paris that the manufacturer of these balloons could furnish no more. The institute was thus reduced to the choice of ceasing the upper-air wind observations or having the balloons made in Holland. Experiments began at once and continued more than a year, and now it is announced that they have been entirely successful. It is stated that the small and light rubber bags made in an automobile garage at Utrecht can, after undergoing a certain chemical process, be easily inflated into large balloons which are plainly visible in the air. Further, it is claimed, observations with these balloons can be made at a greater height than was ever possible with the imported ones. On favorable days, observations have been made at a height as great as 15 kilometers (9.32 miles). As these balloons are pure white and transparent as glass, they are said to form a peculiarly favorable image in the telescope—different from the former imported balloons, which had a golden tint that detracted from long-distance visibility through the telescope.

Science

An Indian "Miracle" Explained.—A note in *Nature* refers briefly to a lecture by Sir J. C. Bose, which describes and explains a bit of Hindu wonder-working—the "praying palm tree" of Faridpur. At the time of evening prayer the tree is seen to bow its head in prostration, and it resumes an erect attitude the next morning. The lecturer devised special apparatus to record continuously the movements of the tree by day and night, and thus discovered that the movements were due to the diurnal change in temperature. Movements of similar origin were found in all other trees tested.

Amundsen's Coming Expedition.—The prospects now are that Capt. Roald Amundsen's oft-postponed Arctic expedition will really start this year. The plan is to leave Norway in June or July and proceed east along the coast of Siberia as far as the De Long Islands, or at least as far as the New Siberian Islands. If this ambitious undertaking is successfully achieved, the ship will enter the pack, with a view to drifting across the North Polar basin and emerging between Greenland and Spitsbergen. It will be recalled that the original plan was to enter the pack at a point north of Bering Strait. Captain Amundsen hopes to complete his journey in four or five years, but will be provisioned for seven. His new vessel the "Maude," was especially constructed under his direction with an egg-shaped hull, to resist the pressure of the ice.

An Integrating Counter.—Congress last year authorized the Census Bureau to spend $60,000 in the development, improvement and construction of tabulating machines, and half of this amount has been allotted to the development of an "integrating counter", *i. e.*, a counter which will not merely record and add units, but will also record and add numbers, thus performing automatically the work done by the operator of an ordinary adding machine. It is said that such a machine is needed not only for tabulating census data, but also for doing cost accounting and similar work in other Government offices. Several types of integrating machine are now manufactured by private concerns, but their use by the Census Bureau is undesirable not only by reason of their cost, but also because the control of the tabulating devices used by the Government should not be in the hands of one company.

An Object Lesson in Farming Poor Land is described by Prof. W. Somerville in the *Journal* of the Board of Agriculture (London). Seven years ago the writer secured possession of a farm of 530 acres, aptly named "Poverty Bottom," located on the South Downs, in order to put to a practical test the opinion he had previously urged that the improvement of agricultural land in England offers, in many parts of the country, a very promising investment. The thin, poor soil, over chalk, was apparently all but barren. The measures of improvement included a liberal application of basic slag, clearing off gorse, sowing of clovers, including wild white clover, and mixture of cattle with sheep on the pastures. The head of stock has increased 50 per cent, besides improving in quality, and the net financial returns, while varying from year to year chiefly with the weather, after deducting losses, rent, etc., averages $338 per annum, together with a free house, on an investment of £4,000.

The Growth of the National Physical Laboratory (the approximate British equivalent of the U. S. Bureau of Standards) was set forth in a recent lecture by the director, Sir Richard Glazebrook. As recently as the year 1901 the staff comprised three scientific assistants, working in some small rooms at Kew Observatory, together with the former staff of the observatory (since transferred to the Meteorological Office). The income was then about £5,000. On April 1st, 1918, the staff was organized in eight different departments, each with its own superintendent and a large corps of scientific assistants and observers; a total of more than 500 persons, of whom about 180 are women. The annual expenditures now amount to more than £100,000, having increased from £38,000 since the beginning of the war. The laboratory has, of course, done a large amount of special work occasioned by the war, including very important investigations in aeronautics, the details of which are at present kept secret. Sir Richard says that "when the day comes on which the tale can be told, it will form a striking example of the work of a laboratory of industrial research, and the results obtained for purposes of war will bear fruit in the rapid progress of civilian aircraft." The laboratory has five air channels in nearly continuous use, and more are being erected. In spite of the name "National" this laboratory has heretofore been maintained chiefly by the Royal Society and six technical societies. On April 1st of the present year its property was vested in the Imperial Trust for the Encouragement of Scientific and Industrial Research, while its finances passed under the control of the Committee of the Privy Council for Scientific and Industrial Research. The work of the laboratory will, however, still be supervised by the Royal Society and an executive committee including representatives of the leading technical societies.

Engineering

Our Output of Steel.—We are turning out steel at the rate of 33 million tons per annum for our Government and other essential requirements. We must furnish Great Britain with 300,000 tons of steel plate, Japan with 200,000 tons and Italy with 60,000 tons.

Industrial Buildings with Columns Set Back.—A new form of factory building has recently been coming into use in which the columns are set back from the walls. The purpose of this is to give a continuous stretch of glass for the walls of the building which will admit considerably more light than the normal construction in which the column forms part of the wall. The floors of the building are supported either on brackets or else they have a cantilever projection beyond the columns. A good example of this construction is found in a seven-story and basement structure built in Chicago last year. The floors project six inches beyond the outer line of the columns, giving a clearance of three inches between the column and the glass. For architectural purposes, the columns at the corners and those next to the corners are built flush with the walls. As a result of this construction not only is there a considerable increase in the amount of light introduced within the building but the ventilating surface is increased over twenty per cent.

New Product from Nickel-Copper-Iron Ore.—In a paper recently read before the Canadian Society of Civil Engineers, Lieut.-Col. R. W. Leonard explained the utilization of Sudbury ores, to produce steel of high strength. In these ores there is a large content of copper and nickel in combination with the iron. The new steel was found to give results under test that were fully equal to those of nickel steel. It showed an ultimate strength of 70,000 to more than 100,000 pounds per square inch, with a yield point of 60,000 to 80,000 pounds per square inch, and showed properties which would make it a very satisfactory material for use in the manufacture of ordnance and bridges. New material is not yet on the market but its cost should be very low. Direct use of nickel-bearing iron ores is not new, but heretofore instead of trying to use nickel-copper iron ores direct in the smelter, efforts have been made to get rid of the copper. The Canadian experiments, however, show that a very satisfactory result can be obtained by a special treatment of the ores without making any effort to eliminate the copper content.

Eliminating the Jogs in Illinois Highways.—The Illinois State Division of Highways has recently adopted a standard design to do away with the jogs in its roads. Illinois roads are laid out on the section line system, running due east and west and due north and south; but on account of the curvature of the earth the roads running north and south must necessarily converge toward the north. This makes it necessary to put a jog in the road every so often in order that the township lines may have their full six-mile length east and west. This correction due to the curvature of the earth is not made at every section corner, but at certain points where the error in bearing accumulates to an appreciable amount. At these points, the traffic has to follow a sharp reversed curve in passing from one meridian road to another, and there is serious danger of accident. The recent decision of the Illionois Division of Highways provides for eliminating these jogs by purchasing the right of way at the opposite corners and putting in an easy curve with plenty of clear space at each side so that drivers may have an uninterrupted view and thus avoid accident.

Fighting Ice with Air.—One is apt to overlook the fact that ice has a coefficient of expansion which is quite considerable. This shows itself where there is a sudden thaw which may raise the temperature of the ice many degrees. If the area of ice is large the expansion will result in upheavals along the shore line. The dam across the Mississippi at Keokuk has had a great deal of trouble with ice. Last year, following a cold snap, in which the thermometer rested at 18 degrees below zero for five days, there was a sudden rise of temperature. The water in the lake behind the dam expanded and exerted a tremendous pressure against the structure. The rounded piers at first broke up the ice which bore against them, allowing the entire thrust of the ice fields to come against the gates. It was estimated that the pressure amounted to 3.7 tons per linear foot. To overcome this condition, the engineers attempted to thaw away the ice from the gates. By means of a steam jet, a line of clear water three inches wide was provided back of each gate; but this was a slow process which required the work of six men operating for 36 hours, as there were 119 gates to be treated. Obviously, the operation was expensive and some simpler method had to be devised. Then the experiment was tried of introducing compressed air back of the gates, the purpose of which was to keep the water in motion. It was found that less than two cubic feet of free air per minute would keep clear an area of 20 feet in diameter. The air was introduced at a depth of 18 feet below the surface, and it carried the warmer water from below to the top, maintaining a continuous circulation which prevented the ice from forming.

Reconstructing The War's Maimed

How Canada is Meeting the Problem of the Crippled Soldier

OUR maimed soldiers are already flowing back to us from the battlefields of France. Like all other nations engaged in the great war, we too are shortly going to be brought face to face with the problem of caring for the warriors who have sacrificed so much for our freedom. And it will be a big problem; for in the present war the percentage of crippled soldiers is far greater than in any other war.

The lot of the crippled soldier, numerous as he may be in a long drawn out conflict, is going to be a far happier one than ever before. A new light has been shed on the subject, with the result that nations no longer look upon the loss of an arm or leg or both eyes as the termination of a man's productive career. Instead of pensioning off the crippled soldier as was formerly the practice, the new order of things calls for the reconstruction of that human wreck, in order that sooner or later he may be returned to normal life, ready and fit to fill some useful function in the workaday world.

In most artificial limb plants the workmen themselves wear some of the products which they turn out

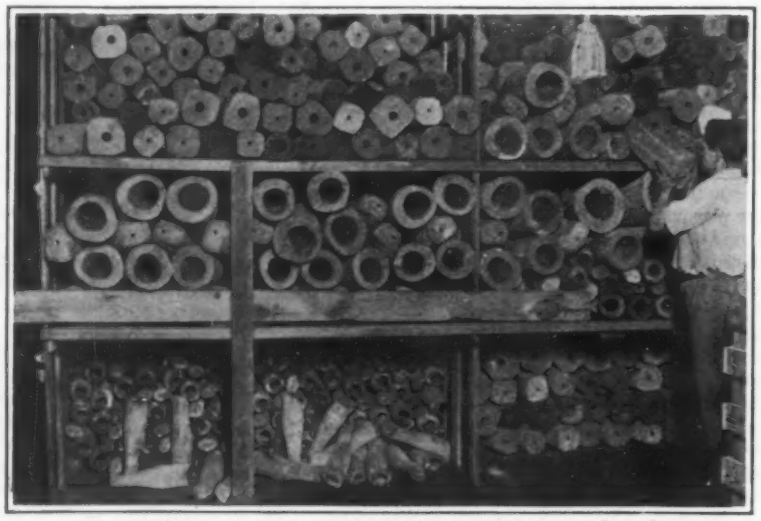
Canada has had her own cripple problem and has met it with thoroughness and dispatch. The Dominion, following the trend of other nations engaged in the war, set about reconstructing her returned soldiers for normal life. Among other phases of the work of our northern neighbor is that of furnishing limbs to crippled soldiers, which must always be considered part of the debt each nation owes to its fighters. And now, because we are in the war, much interest attaches to Canada's work along these lines.

Considering the number of Canadian soldiers who have been wounded in action, the number who have been submitted to major amputations is remarkably small due no doubt to the splendid work of the advanced dressing posts of the Red Cross forces. To date the number of amputation cases reported is in the neighborhood of 700. The Military Hospitals Commission has accepted the responsibility of the Government of Canada to provide such artificial limbs as are required and to maintain them during the lifetime of the soldier.

For the purpose of living up to this responsibility several conditions made it necessary for the Commission to establish its own factory. Many privately owned factories were making limbs of different standards, but, owing to the condition of the market for this commodity before the war, none had very great capacity for production. The government's access to all the best patented features of any or all of these types of limbs made it inadvisable to place a contract with one factory, and ordinary business sense forbade buying different types of limbs from many different factories scattered all over the country to be distributed by one agency. The market price of artificial limbs also is based on sales conditions, which are very slow. The cost to the country of limbs manufactured in the Commission's own plant is that of labor and material only.

The very best arms and legs yet devised anywhere in the world are provided by the Commission. The materials used are the best obtainable; skimping is not tolerated in the least important factor.

In fitting the limbs patience is necessary to insure a maximum of comfort for the wearer. Experts at this art pay close attention to the slightest irritation or discomfort reported by the wearer, whose limb is never finally finished until every undesirable feature has been eliminated. A civilian who for some time has used an artificial leg similar to one provided by the Military Hospitals Commission has been engaged to demonstrate to the boys the possibilities of its use. From his achievements it is hoped that the soldiers will derive confidence, and that their determination to persevere in practicing will ultimately lead to success.



The wood is cut into bolts and bored through the center in order to season without checking

What can be done is indicated by the fact that this man can run, box, dance and walk as well as a proficient exponent of any of these arts who may have two sound legs. The demonstrator has made a study of the potentialities of artificial limbs and is familiar with such incidents as that where a man on two artificial legs, one beginning above the knee and the other below the knee, ran 100 yards on a Chicago track in 15 seconds.

Splints, braces, orthopedic shoes and other orthopedic apparatus are also manufactured by the limb factory with the same care as that used in the making of limbs.

At the present time the Commission issues an artificial arm with a working hook which is capable of holding a knife, fork, or pen, and by which a man can dress himself, eat or write as well as with his own hand after a period of practice. It holds tools and picks up articles. It is known as the utility hook, and one man working in the factory served his time and became a journeyman plumber with a similar tool. The hook can be exchanged as desired by the wearer for a gloved hand with a workable thumb. With this dress hand a man can hold an umbrella or a valise, or carry his coat on his arm comfortably.

Before long the Commission will be issuing a hook capable of holding like a vise anything that can ever be held in a man's hand. Even a polished chilled steel bar cannot be made to slide in the viselike grip of this hook.

The artificial legs are made of a variety of willow taken from two trees of the willow family, both of which are exotics. They were brought to America from Europe and have naturalized themselves over the eastern States and Canada, until they are now more plentiful than the native willows. These are the Brittle Willow and the Golden Osier, both well-known lumber trees of Europe. This wood, when absolutely dry, weighs about 26 pounds to the cubic foot; it is tough, does not split readily and works well in the tool. The wood is cut into bolts about 22 inches long and bored through the center in order to season without checking. It is barked and the ends are painted and the bolts are then left to season in the shade in the open air for two years. After this the bolts are kiln dried and are kept bone dry till they are delivered to the man as an artificial limb. At the factory in Toronto there is a large dry kiln on the premises for that purpose.

It is the practice of the factory to work the wood up into rough legs and to put these in stock in sizes on a basis similar to the method of stocking boots. Several lengths of legs, allowing for variations above and below the knee, all have their respective size numbers, and six sizes of feet are also accounted for.

When a man is sent by the medical officer to be fitted for a limb, his measurements are taken and the stock limb most nearly approximating his measurements is tried on. The top artificial leg is then hollowed with special tools made for that purpose, and in above-knee amputations the stump leg is fitted into the socket until the patient bears his weight on the pelvic bones, virtually

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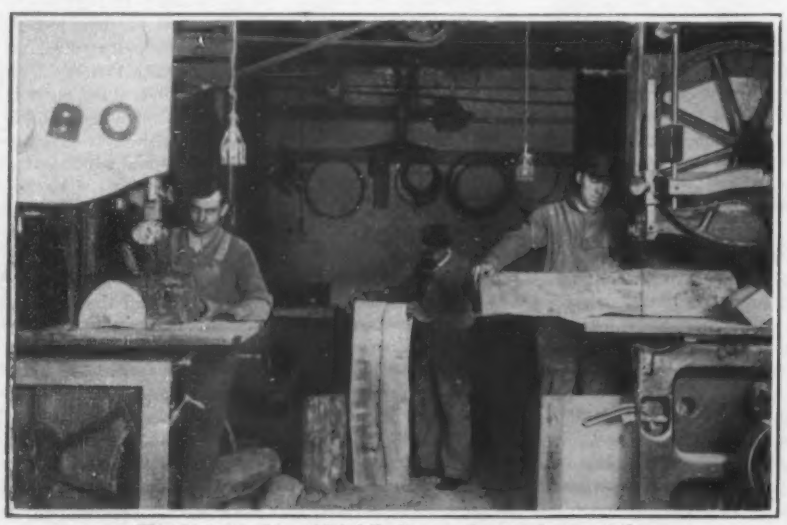
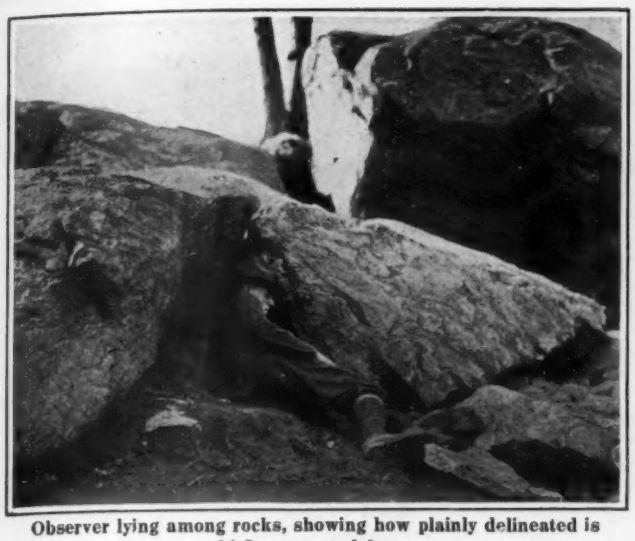


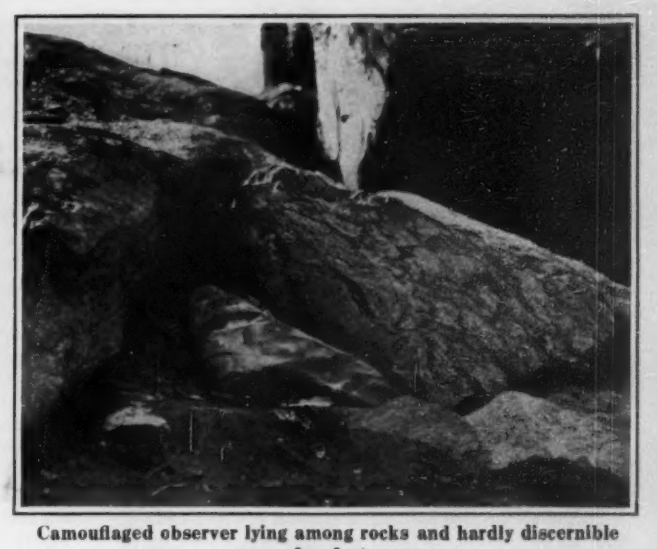
The first step in artificial-limb manufacture is to cut the rough wood into suitable pieces

The fitting of the limbs to the crippled soldiers calls for great care and infinite patience



Observer lying among rocks, showing how plainly delineated is his unprotected form

Camouflage robe worn for sniping or observing



Camouflaged observer lying among rocks and hardly discernible even a few feet away

Seeing But Not Seen

What Our Camoufleurs Are Learning Day by Day in Their Newly-Found Art

OUR first camoufleurs were amateurs and volunteers—artists and sculptors who saw the possibilities in applying their knowledge and skill to the conduct of our war. Less than a year ago Berry Faulkner, a New York artist, and Sherry Frey, a New York sculptor, started a volunteer organization of 19 men who trained in a studio in Greenwich Village, the Latin Quarter of New York city, so to speak.

Opportunity soon knocked at the door of the little band of camoufleurs. Soon General Pershing was cabling back to the War Department for camoufleurs to the perplexity of the men in Washington, for camouflage was then but little more than a mysterious word to us who were still unfamiliar with the ways of modern war. At this moment, however, Faulkner and Frey and their 19 men offered their services to Secretary Baker, and were accepted in a body. Evarts Tracy, a New York architect with Plattsburg training, was appointed major. Recruiting was started in earnest and soon the little band of camoufleurs was expanded to a full company, with many of America's well-known illustrators represented in the roll call.

Company A, U. S. Camouflage, was dispatched to Fort Meyer, Va., and there attached provisionally to the 25th U. S. Engineers. It did not take long for the camoufleur cadets to establish their camp, which, with its tents, arsenals and mess shacks, was similar to other American camps. But the similarity was only temporary; for soon the camoufleurs set about camouflaging their quarters until the various buildings and tents took on the appearance of a peaceful landscape. And from that time on they learned the mysteries of camouflage for themselves, since there were no books or other guides on the subject.

The whole purpose of camouflage, of course, is to deceive the enemy. In fact, the strategy of modern warfare resolves itself into the problem of seeing what the enemy is doing while preventing him from seeing what you are doing. Unfortunately, the enemy is quite as adept at this game as we are, and the result is that a modern campaign is very much like a game of hide-and-seek with a penalty of death and destruction for the unsuccessful player.

Camouflage takes on many different dresses, but the end is always the same, namely, hiding from the enemy. One of the problems is the elimination of high lights in artillery, which is met by protective coloration and deceptive screens. The coloration is generally of the spotted variety, using such colors as are present in the surroundings. The screens are made of leaves and shrubbery held in place by the strands of huge nets. Tanks are protected against enemy shell-fire by various color schemes, the one generally favored being a vivid combination of colors which blend into an indistinct mass when viewed from a distance. The helmets of the infantry must be protected by camouflage, for in their original state their highly polished surface reflects light rays and attracts enemy fire. So helmets are provided with canvas covers or sanded over or covered with powdered glass in order to break up the reflected rays. Weapons are sometimes greased in order that they may not betray the infantry by reflected rays. Uniforms, ranging from the khaki of our men to the horizon blue of the French and the gray-green of the Germans, are designed to melt into the surrounding landscape over which a battle is fought, and this again is a matter of camouflage. Moving vehicles are protected by roads overhung with screens, so that prying enemy airmen cannot see them. Indeed, motor trucks and guns and horse-drawn carts are often covered over with leafy boughs and layers of hay to disguise them.

American ingenuity has had a chance to display itself in our new camouflage art, and already it is reported that Homer Saint Gaudens, son of the great sculptor and a first lieutenant in the company, has invented a machine which converts old newspapers into blankets that can then be tinted like the surrounding grass and used as a cover for a body of men going up to the front. Lieutenant Wilfred Conrow is credited with the invention of an invisible helmet, while other men of the company are busily engaged in the many other ramifications of camouflage.

Of late there has been formed another body of amateur camoufleurs known as the 1st and 2d platoons of the camouflage class conducted by the New York Board of Education. The members are volunteers bent on receiving instruction in this branch of military service with a view to serving in that capacity when their turn comes to be inducted in the Army. Two evenings each week find each of the platoons busily engaged in camouflaging miniature ambulances, tanks, guns and other battlefield objects to conform with the color scheme and topography of miniature landscapes. These landscapes, made of plaster, represent sections of Van Cortland Park and other New York city landscapes, and are laid out accurately to the scale of about one inch to five feet. On Friday evening the two platoons meet at an armory, where they receive regular military training, and on Saturday the two platoons attend lectures. Map drawing is also included among the studies of these camoufleurs.

Under the command of Lieut. H. Ledyard Towle, the New York camoufleurs meet every Sunday in the vicinity of New York for field work. The accompanying illustrations are no doubt the best means of telling just what kind of work is done, for they show the various applications of camouflage robes designed and painted and worn by the students to conform with such natural surroundings as trees and rocks. The robes are painted with special water colors to agree with the surroundings where they are to be used, and by means of such protection it is possible for the wearer to creep close up to an enemy position without being detected. It is well to add that the photographs in some instances do not do justice to the camouflage, because they show deep shadows and betray the wearers, which would certainly

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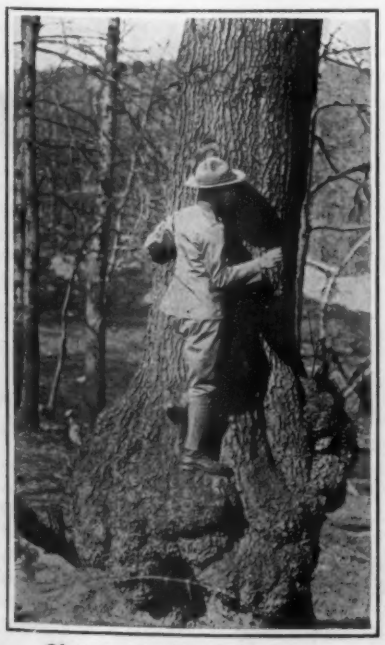

Observer standing behind tree, without camouflage

Part of the class of New York camoufleurs receiving instructions from Lieut. H. Ledyard Towle

Observer wearing camouflage robe to match tree trunk

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

The Place of Paper in the War

MUCH has been said of the "scraps of paper" and the "notes" which have featured the war and all colors of "papers" have been published by the various belligerents not to mention the extras of the daily press and the *Congressional Record*. But paper and pulp have found new and noteworthy fields of usefulness.

It is well to remember that the fundamental substance of pulp and paper is cellulose, Nature's most abundant building material which we use in many forms from cotton fiber to heavy timbers. In reality paper is just cellulose in the form most suitable for certain purposes and capable of being shaped in a multitude of ways.

As metals furnish so large a portion of the sinews of war, we have turned to paper and pulp to replace them in such things as containers for food and merchandise. The problems presented are both mechanical and chemical, for a way had to be devised for producing a heavy wall and means for closing the ends more securely than is possible with a slip-on cover. At the same time all inner surfaces must be treated to protect the food or other contents and to prevent absorption by the package. The walls and seals must be such as to retain even the delicate aroma of skilfully blended coffee.

This important problem is practically solved. Tubes of the required diameter are built up and closed by a machine which rolls cover edge and tube end together more securely than a double lap seam. The chemist has seen to proofing the surfaces.

Pulp prepared as for paper making, but more thoroughly purified, has found extensive application in the field of explosives and large quantities are reported used in Germany for this purpose in the absence of cotton. Some pulp is said to be used here for nitration, but the necessity of employing it largely is not yet here.

We are, however, making progress in adopting highly purified paper pulp to supplement our supply of absorbent cotton. This pulp is like a collection of poorly formed sheets of very white tissue and has a capacity for absorption many times that of cotton. It is especially well suited for sponges, pads, and similar applications when held in gauze. Crepe paper bandages have proven useful, and they possess a considerable advantage in being somewhat elastic, thus avoiding any undue pressure resulting from tight bandaging or hurried work.

A paper has been devised for the Red Cross, such that it may be used as a wrapping for dressings, etc., which are then sterilized. The paper has the peculiar property of being sufficiently porous to permit efficient sterilization, but during cooling these pores close and the paper covering affords ample protection.

There is little likelihood that Americans will be required to use paper clothing, such as may be in use by the Boche, but the possibilities are interesting, at least along the line of replacing burlap and other coarse fabrics. The absence of a demand has made our progress slow, excepting in the manufacture of paper twine and cordage with and without cores; but the step from these to paper yarns is a short one. The flexibility, fine texture, ability to take dyes and good appearance of paper yarns is remarkable, while cloth attractive for many purposes may be woven entirely from such yarn or paper may be used as a filler with cotton or artificial silk warp. The all-paper fabric is inclined to be coarse and harsh, but it answers well for bags, etc., while other varieties should serve well in upholstery and wherever it will not be subject to much washing in water.

The better paper yarns are made by twisting narrow strips of conditioned sulfite pulp paper, properly bleached and sized or dyed, and otherwise finished to give strength, a degree of water-proofness and the best possible appearance.

A patent reinforced paper has lately been perfected which also answers well in the place of some cloth. This paper is composed of two sheets held by a waterproof compound applied as an adhesive. Between them jute or cotton yarn is ingeniously woven in a manner to give maximum strength and resistance to tear, the weaving progressing simultaneously with the cementing. One of the more recent applications of this paper is in the making of moisture proof and wind proof vests for our men "over there." For this purpose a soft crepe paper is used in place of the usual kraft, the edges are tape-bound and the garment is easily tied on, thus avoiding the use of buttons.

Useful Cobalts

ALTHOUGH cobalt was long considered an element of doubtful usefulness, cobalt alloys have been available for some time. The war has brought them into more prominent uses and this is especially true of stellite, an invention of Mr. Elwood Haynes, who has paid special attention to cobalt alloys and the alloys of the less common metals, chromium and tungsten.

Stellite is not a definite compound. Some of it may be cast while other types are malleable at a red heat. These malleable alloys are composed mainly of chromium and cobalt, the percentage present varying greatly. They are hard, cannot be machined, and when more than fifteen per cent of chromium is present nitric acid is resisted almost completely. At 750 degrees to 1,200 degrees C. stellite may be forged with difficulty and it is well suited for tableware, surgical instruments, chemical apparatus and jewelry. Its color closely resembles platinum, while its luster is higher and better retained than platinum. Stellite therefore would seem to offer a satisfactory substitute for platinum in jewelry.

The malleable alloys are but slowly attacked by hydrochloric, sulfuric and hydrofluoric acids and are practically immune to the action of other chemical compounds including fruit acids. Hence the usefulness of these hard alloys, which take and hold a sharp edge satisfactorily for knives. In ordinary uses very little scratching or abrasion occurs. Caustic alkalies may be boiled in stellite dishes and because of a tensile strength exceeding one hundred thousand pounds per square inch and considerable elongation, the danger encountered when evaporating solutions of salts to complete dryness is avoided. Evaporating dishes for laboratory use may be made with very thin walls and because of the high polish which stellite takes they present a beautiful appearance.

When heated to full redness, stellite becomes covered with a blue-black film which however does not change in weight or appearance after repeated heating and as no scale forms, the alloy retains its weight together with stability and a smooth surface under all sorts of usage. Stellite may be subjected to a temperature of 1,200 degrees C., more than 2,100 degrees F. and still retain its strength to a marked degree.

It is the ability of stellite to do more work than other alloys when used as a cutting tool that has made it of great value in war time. Tungsten steel will do three times as much work as carbon steel as a cutting tool and this alloy of cobalt, chromium, and tungsten—stellite—is reported to be able to do at least fifty per cent more work than tungsten steel. This means that machines equipped with such tools can be run at a higher speed and that means much to production.

Stellite is a promising material in many respects and when we learn more about its manipulation many new fields of usefulness for it will undoubtedly be found.

The Relation of Sulfur to American Independence

QUITE recently at the Chemists Club there was hung a portrait of an American chemical engineer whose conception of a brilliant idea and whose faith to follow it through has proven to be of basic importance to us in the present great emergency. We refer to Herman Frasch and the sulfur deposits of Louisianna and Texas.

Sulfur, always an essential, has assumed a new importance lately in that in some form or other it is the starting point in sulfuric acid manufacture and this acid is necessary in most chemical processes. To produce nitric acid Chili saltpeter is treated with sulfuric acid and it is employed together with nitric acid in nitration. Munition production would be impossible without large quantities of sulfuric acid. It is also required in the fertilizer industry which has a direct bearing upon food supply and is a raw material in refining processes, glucose manufacture, the dyestuff industry, metallurgy, and many other important lines.

Sulfur, as such, finds application in gunpowder, matches, rubber vulcanization, germicides, bleaches, etc. So the progress of the race depends upon sulfur just about as much as upon any one single element.

Sulfur occurs as pyrite, a combination with iron, copper or other metals, as sulfate such as gypsum and free or native sulfur in various conditions. For years Sicily controlled the world's supply, large bodies of native sulfur mixed with rocky materials occuring there as in many volcanic regions. By a simple process of heating, in which a portion of the sulfur is burned to supply heat, it is melted and collected as it runs away from the rock. The purity of this product is sufficient for many purposes and when a higher grade is specified purification is accomplished by distillation in earthenware retorts.

Spanish pyrite has always commanded a good market because of the metallic by-products secured when the ore is roasted. Both Spain and Sicily involve transatlantic transportation which at present would make our sulfur supply most uncertain and our domestic pyrite is unequal to the demand. Hence the importance of Frasch's work.

Sulfur sometimes is found in vast beds believed to be the result of bacteriological action by which such substances as gypsum have become reduced. Some of these deposits were found in Louisiana about 1,000 feet below the surface but because of sands, gases, and other obstacles, persistent efforts to mine the sulfur had failed when Frasch conceived the idea of pumping it to the surface.

Sulfur has characteristics so peculiar that engineers were free to predict failure for the proposed plan. At 114.5 degrees C. the material melts to a very liquid free flowing mass, but just above 119 degrees C. sulfur becomes viscous and sticky, which properties increase until at above 160 degrees, a dish of sulfur may be inverted without spilling. Beyond 260 degrees the material becomes more mobile finally boiling at 445 degrees, passing into sulfur vapor. The plan under discussion involved controlling temperatures between 114.5 degrees and 119 degrees a thousand feet below the earth's surface, and it must be admitted that only four and a half degrees C. leeway was under all the circumstances sufficient cause to give any engineer concern.

It was argued that by forcing superheated steam down a pipe and around a concentric return pipe the native sulfur could be melted and then forced by air above the point to which it would naturally rise. Great faith in the ultimate success of the method was required to proceed in the face of the frankly expressed doubts. The evidence really seemed to be on the side of the doubting Thomases and experiments on the scale contemplated were anything but inexpensive.

To the contrary notwithstanding, the work progressed. The pipes went down, pumps were placed and a large battery of powerful boilers installed. A place to run the sulfur to be brought up was provided! One by one the obstacles were overcome, and soon sulfur nearly chemically pure—over 99.5 per cent—was being allowed to flow into wooden forms to cool.

By and by as the sulfur piles approached the size of houses there came a cessation in the stream of yellow liquid and it was surmised that such a hole had been melted in the deposit that it had become impossible to heat the body of condensed water taking the place of the sulfur. The question became how to fill the hole with something that could be heated. A satisfactory solution was found in dry sawdust which could easily be forced down where it would immediately swell up in the accumulated water. Sulfur production then proceeded with few interruptions.

Clam shells are constantly tearing down the huge sulfur blocks to fill car and barge and the pumps go on building up still other blocks. The method is now in use elsewhere and is known as the Frasch process. Seems simple enough, doesn't it? So simple that it is small wonder the English syndicate controlling the Sicilian sulfur refused to believe it.

The story is that in explaining a falling off in sales in the United States, a representative of the syndicate reported that the Yankees were pumping purer sulfur from the ground than could be mined in Sicily, to say nothing of transportation, etc. Aghast that the agent should pass on such a Yankee exaggeration as a serious report, he was promptly dismissed and it eventually cost the syndicate a handsome sum in their endeavor to compete in price before they would accept the truth.

Only the humanitarian principles of the American company in making agreements with the Sicilian interests in which negotiations the Italian government was concerned, has made it possible for the Sicilians to continue to earn a livelihood through sulfur production and refining.

The production of sulfuric acid is an interesting story in itself and, for the purpose of emphasizing the importance of sulfur produced right here at home, data on the acid production of the last two years will be useful. The degrees used in describing the variety of acid are "Beaume" a French system of stating specific gravity.

	Short Tons 1916	1917
50 degrees	1,829,471	2,306,372
60 "	1,119,753	1,187,704
66 "	1,580,100	850,006
Stronger	443,332	1,190,019

Totals of the columns convey little because of the great difference in actual strength between the higher acids which are separated by but a few degrees. The 1917 gain in the so-called "stronger" acids is quite significant.

In view of all this, why has there been a shortage in sulfur? Remember that the increase in demand was comparatively sudden and most of all that ours is a big country with many transportation problems. But we cannot help wishing we had allowed science to prepare us equally well along other lines and in other fields.

The Port of Providence

How the Dreams of the Rhode Island Capital are Gradually Being Realized

PROVIDENCE is to be made the most important oil distributing port on the Atlantic seaboard. This assertion may be scoffed at by the incredulous and the uninformed, but the fact will be clearly established when operations to begin this spring are completed, and the plans of the great oil companies are fully consummated.

These undertakings are but a part of the improvements had in mind by those who worked so diligently and earnestly for the betterment of the harbor; efforts that covered quite a number of years and that met with substantial results about five years ago.

Those who had faith in a great future for the harbor of Providence worked early and late to encompass that end. They had imagination, and they had visions of a harbor which should float upon its bosom big ships from over the sea, as well as the great freighters from southern ports—a harbor with sufficient depth of water and a channel wide enough to accommodate any ship and many of them at a time. A harbor which should be lined with docks on either side at which the riches of other markets should be deposited. Much of this freight naturally would remain in Providence, but vast quantities would be carried northward, for this is the Southern Gateway of New England, and through it must annually pass millions of dollars worth of products, both coming and going.

For years Providence was at the bottled-up end of Narragansett Bay, with inadequate transportation facilities and unpromising railroad connections for freight-handling purposes. Harbor Junction and the Wilkesbarre Pier afforded means of getting coal around the city via Elmwood on the west and south, and East Providence and East Junction on the east and north. Every pound of freight of a miscellaneous character had to be trucked across the city if it arrived via the New York boats, and relief from this situation seemed impossible of attainment.

What dock facilities there were worth using south of the Point Street bridge appeared to be held down by the New Haven system. There had been a gradual bottling up of the harbor and none might make use of any of its desirable features unless permission was granted by, and tribute paid to, the New Haven.

For a painfully long number of years the Federal Government had been appealed to to give Providence a harbor worth while, and a river channel worthy of being called one. There were desultory appropriations obtained, all far from adequate, considering the importance of the port. Congress now and then tacked something for Providence upon the River and Harbor bill—something that probably was not wanted for some inland mud creek, or that could be pared off the substantial item set apart to improve a river which had no commerce save that which existed in lively imagination.

"The most advantageous bay on the North Atlantic coast—equally advantageous in time of war and of peace; an unsurpassed strategic base; an unequalled haven for warships; the bay which served as the key to southern New England, and afforded every facility to all this part of the country; which could handle Canadian as well as State shipments, begged hard and caught the crumbs that fell," is the way the Providence Chamber of Commerce puts it. And that this is no idle assertion is borne out by the fact that, comparatively undeveloped as Narragansett Bay and its tributaries are, they carry annually more commerce than the entire Mississippi River system, with the exception of the Ohio branch. Still the Government, since it took its place on the map, has spent upon Rhode Island waters less than one per cent of the appropriations made or authorized for the Mississippi Valley. The State of Washington in one year received four times as much money from the Government as the State of Rhode Island, although the tonnage of the two was about the same.

Providence wanted not only a better and deeper harbor, but it desired that the narrow entrance to it at Field's Point should be widened by removing the long sand spit; that the channel should be widened and straightened southerly of Field's Point, and that both harbor and channel should have a uniform depth of 30 feet at mean low tide.

It seemed almost useless and hopeless to ask for these improvements, but the Providence Chamber of Commerce, following up with precision and efficiency the efforts of its predecessor, the Board of Trade, succeeded in enlisting the attention of Congress and in obtaining the promise of a substantial appropriation, provided the city and state likewise responded.

The General Assembly immediately got busy. So did the City Council. The Federal Government expended about $1,000,000 upon the work called for. The city expended about $800,000 and donated land to afford a more direct approach to the wharves. The state voted to expend $1,500,000 for public docks, and the city prepared to build a quay that should in part be open to lease and in part to the general accommodation of transient shipping.

The Government carried out its part of the compact by cutting the nose off Field's Point, digging out the harbor and making a straight-away, 30-foot channel to deep water. The state built a big pier and on this erected a shed and storehouse combined, fitting it up in part, to accommodate the business of the immigration department, for the Fabre lines were already making this a port of entry and were doing a fine business between France and this country.

The city improved Field's Point by building a quay 3,000 feet long, with 30 feet of water at mean low tide, and thus far expended $699,914.86 on that work. It is now to spend about $175,000 for a traveling crane and other sea-wall equipment and freight-handling apparatus. It will spend $75,000 more in obtaining additional land.

The New Haven Railroad has built connecting tracks and numerous sidings to facilitate the moving of freight, and the Grand Trunk system has acquired nearby land which will permit it to complete its tidewater connection with the unfinished work to the West. The Grand Trunk, or rather the Southern New England Railway which it owns, will become a reality when the European war is over. Mile after mile of the finished right-of-way is now lying in abeyance, for the corporation depends upon English and Canadian financial backing, and must wait for this until those countries have settled their accounts with the German war lord.

The advantages of the port of Providence have been seen by numerous concerns and they have not been slow to obtain bases along the City Quay. The Federal Government, recognizing the advantages of the port and the handiness of Field's Point, commandeered something like fourteen acres of land to the west and southwest

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Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Cast Rock Salt

To the Editor of the SCIENTIFIC AMERICAN:

I have read with interest the article in your issue of April 20th, signed by S. P. Dunnington, in reference to cast rock salt.

There is nothing new in melting and casting salt. As western manager for the largest salt manufacturers in the United States, I was directly concerned with experiments made in Hutchinson, Kan., in 1914-15, to determine whether salt could be cast into 50-pound blocks, as an improvement on the compressed block. A large gas-fired furnace and cast-iron double molds were used. The foundry was laid out according to modern practice and thoroughly equipped.

No difficulty was experienced in melting and casting the salt, but the experiment was a failure, as the blocks were not sufficiently tough to stand shipping. A large percentage of them fractured on cooling, whether allowed to cool in molds or removed and piled. A slight blow was sufficient, because of internal stresses, to break the block. The blocks were approximately 8x8x12 inches. Experiments were made with 25-pound blocks, but with no better results. As smaller blocks would not have been commercially practical, no large scale production of them was attempted.

The structure of the blocks was most interesting. An outer crust about an inch thick was secured having a fibrous texture, with the crystallization perpendicular to the outside edges. This was very hard, giving the block the appearance of having been glazed. The interior, however, was of an entirely different crystallization and rather soft, although of considerable density.

Mr. Dunnington's statement as to the supply of rock salt for the Atlantic States is in error. The chief source of supply for these states, for all grades of salt, is Livingston County, New York, and contiguous districts. In that district there are two large mines which supply the greater part of the rock salt used east of the Great Lakes.

STERLING MORTON.

Chicago, Ill.

A Convoy Suggestion

To the Editor of the SCIENTIFIC AMERICAN:

Your recent article "Ship Builder versus Submarine," certainly shows that no time should be lost in getting all possible tonnage on the seas. As you are in a position to know what is being done, and what has been proposed to relieve the situation, I am taking the liberty of submitting for your consideration a little scheme, which seems to me to be practical and comparatively easy to carry out, and if so it will help considerably in getting the new ships in the water. If you think it worthy of a fair trial, I should be pleased if you *would pass it on to the proper authorities for their consideration*, but if you do not think if of any value, well, just *drop it in the waste basket*, or return with any comments that you may see fit to make. I have no ax to grind other than to help knock the big I out of Kaiser.

Why not equip the cargo ships now being built with electric motors, which can be driven by current furnished by a large high powered ship, instead of equipping each ship with a complete steam power plant? One large high powered ship could furnish enough current to drive several ships of the size now being built at as great or greater speed than they will make with independent power plants. For illustration take the "Lusitania"; on its official trial it developed 68,850 horse-power when making a speed of 25.4 knots, while at a speed of 15.77 knots it only required 13,400 horse-power. Thus at the slow speed of 15.77 knots it had a reserve of 55,100 horse-power, or sufficient to drive four more ships of the same size at the same rate. Surely this is a reserve that could be called upon at this critical time. Of course, the decrease of ten knots in the high powered ship's speed would decrease the tonnage per month that it could deliver, but this would be more than made up by the increase in tonnage that the four motored ships could carry, on account of the lesser weight and bulk of machinery in them, and the absence of fuel tanks or bunkers. (The above figures were taken from the Proc. Inst. Nav. Archts. and I got them from Kent's M. E. Handbook, page 1330; eighth edition.) It would be easier and quicker to build one large high powered ship and four or five motored ships to go with it than it would be to build several small ships with independent power plants capable of delivering the same tonnage. And it would take only a fraction of the men to man a motored boat that it would to man in independently powered boat.

The main advantage of this scheme, however, is that we already have the high powered ships, some of which could certainly be spared for this vital work; take an ordinary second or third class battleship for instance, at a speed of ten knots (the speed of the wooden ships now under construction), it has a large amount of reserve power, sufficient to drive several ships of the size now under construction at as great or greater speed than they will be able to make with their own independent power plants.

While if we take one of the immense 180,000 horse-power battle-crusiers, capable of making 35 knots, it would be able to drive a whole fleet of cargo ships at their normal speed, and would at the same time be assisting in convoying them. Surely this would be a job worthy of any ship that sails the seas.

If I am not mistaken, some of these high powered battleships and battle-cruisers are now equipped with electric drive, this being true, there would be very little alteration necessary to equip them for this sort of work. And it would certainly be easier to install generators in existing ships than it would be to build new ones—and a lot quicker, which is the main thing now.

There should be no great difficulty with the power cables leading from the generating ship to the several motored ships, as they could be made strong enough to tow them if necessary (in fact this would be one way to use the reserve power of high powered ships, by towing, but the electric drive would be better). The ships would have to stay close together, but this is no more than they are now required to do when being convoyed. By keeping abreast of the generating ship they would offer no greater broadside to the enemy's aim than a single ship. I have worked on a dredge boat that was operated by current taken from the shore, and though we were sometimes half a mile from the shore, and the weather a little rough, we never had any trouble with the power cables. Of course it will be more difficult out on the open sea, but I think that there would be very little trouble caused by the current-carrying cables.

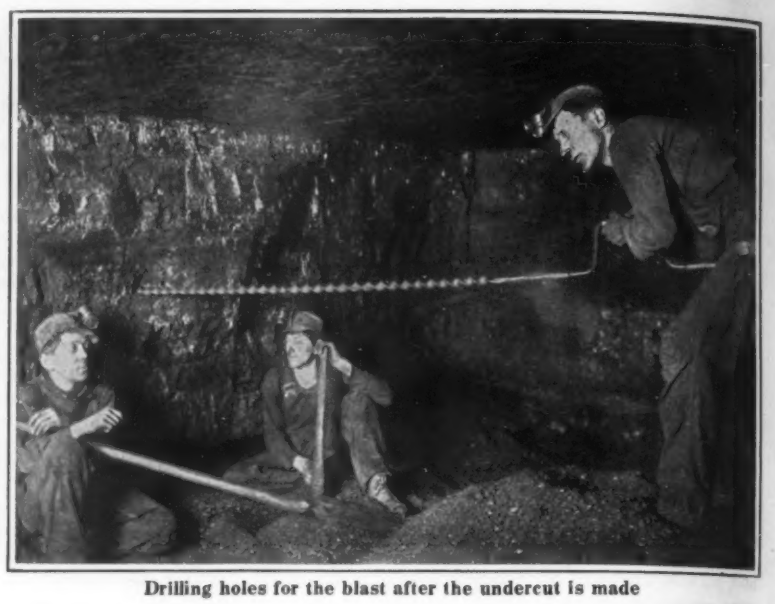
If you think there is any possibility of using this scheme, and that there is anything that I can do to help put it into operation, I should be very glad to hear of it. Am an electrical engineer by education and a few years experience, but am a stock farmer by choice (not just since the war though); am in the draft, fourth class, and am ready to do anything that will help win the war.

Trusting that you will give this matter any consideration that you may think it merits.

J. W.

Centre Point, Texas.

Short-wall machine for undercutting the body of coal



Drilling holes for the blast after the undercut is made

The Man Who Mines Our Coal

The Operator's Point of View Toward the Fuel Shortage of the Past Winter

By D. C. Ashmead, E. M.

IT surely seems that the viewpoint of the mine operator regarding the fuel situation and its solution has neither been presented to the public nor received full consideration by the Fuel Administration. At this time when Federal control of the mines looms large on the horizon, it would seem most important to understand what those most affected think about it, and what they regard as the best avenue of attack upon the situation.

At the present time the country needs 650 million tons of coal per year for all consumers, from the largest manufacturer down to the smallest domestic user. The mines can take out and load on the cars 750 million tons, more than enough to meet all demands. But the railroads can handle only 600 million tons—50 million tons less than the demand of the entire nation.

On account of this inability of the railroads to handle the output of coal, it would seem that the first demand to make good might be addressed to them. If they could and did furnish the mines with an adequate number of cars, sufficient coal could be produced to meet all demands. But it is a fact that the failure of the railroads to supply cars is not the only one; the mining companies are likewise at fault. Their shortcomings are of a sort that cannot be corrected by the operators themselves, but will have to be rectified by Federal control of the mine output, as distinguished from the mines.

Coal mining is an industry peculiar unto itself. In an ordinary manufacturing plant, sufficient space can usually be provided, in either warehouses, sheds, or other places, to take care of the products of manufacture. Possibility of shutdown for lack of cars in which to load the finished product is thus eliminated. With the coal mining industry this is not the case except in the anthracite field, and even there only a few days' supply can be accommodated.

Bituminous coal, in the first place, does not store satisfactorily because spontaneous combustion is liable to take place at any moment. In the second place it deteriorates when exposed to the elements, particularly when it contains a large amount of sulfur. In the third place the space and the investment required for its storage are too great, especially in the mountain regions where, even if the money could be found, the space is not to be had.

Anthracite is not affected by the first two reasons; the third applies to it, but not in such measure as to bituminous. Anthracite can be piled higher, and therefore does not require so much ground or so much investment for its storage. But in the bituminous fields, the great difficulty of storing coal makes it necessary to have the cars in which to load the coal before the mine can be operated.

Cars, Coal and the Coal Miner

Unfortunately during every period of prosperity there has been a shortage of cars; the railroad companies cannot afford to carry equipment to be used only for a short time and then to stand idle for months or years. This car shortage recurring periodically with every wave of prosperity has brought about a labor situation peculiar to the mining industry. It is impossible for the men in charge of a mine to predict, at night, whether there will be cars for the loading of coal the next day. So when work is finished today there is no way of knowing whether there will be work tomorrow; in most cases even the local representatives of the railroad do not know what equipment will be on hand for distribution.

As a result of this condition, the men, when they come to work in the morning and find no cars, go home. This state of affairs lasts week after week and month after month, the mines in many cases working only half time or less. At first, if the men did not find cars on the mine siding, they would wait when advised by the railroad officials that cars would be placed in a half hour or so. But in numbers of cases they went to work on the strength of this assurance, only to have the day pass without cars; so they would go home dissatisfied and disgruntled. After having this happen a number of times, they have naturally given up waiting; and it is now the exception to find them doing so. If the cars are not in place when the miners arrive for work, they quit and call it a holiday although their cars may be placed within fifteen minutes.

The result of undercutting and blasting

This condition is not entirely caused by car shortage. In the lean months of coal production, when orders are few, the operators tell the men whether there will be work the next day. But sometimes they are in hope that they will receive orders in time to start work in the morning and so have the men report for work, only to be sent home again.

All this means that, at a coal mine, from two to two hundred cars, depending upon the size of the mine, are often standing idle for practically a whole day. The only way to rectify the situation is for the railroads to deliver the cars at the mine in time for the day's work; if they cannot do this, they should deliver to some other mine which can be reached on time. Taking the country as a whole, there are probably thousands of cars standing idle at all times—cars which if delivered earlier, by a matter of hours only, could have been loaded.

Another matter that one is led, by reading the current news, to believe worse than it really is, is the labor situation at the mines. In few cases would there be any trouble about wages if the men could only have regular work. It makes no difference to the average miner whether he works or not, so long as he has sufficient money to supply his needs. If he works an average of three days per week, he has to have sufficient money to carry him for the other three days. Therefore he demands sufficient wages from the work that he does to pay him for the work that he is willing to do but which is not furnished him. It is noticed at the mines where the men can work every day that, with the present high wages, it is almost impossible to get them out for more than three or four days unless the patriotism appeal will reach them.

What Is a Week's Work?

At some mines which furnish railroad coal and accordingly can and must work every day, they have gone so far as to raise prices at the mine commissary to such a point that even with the present wage scale the men have to work every day in order to live. This scheme is of course not fair or honest to the men, and some other method should be devised.

But it represents an effort to meet the fundamental fact that the man of little education who works with his hands seldom will work longer than is necessary for his sustenance.

The same tendency is met all over the world. We have heard of an extreme case in Mexico, where a copper company new to the field and under inexpert direction fixed its wages so high that a native worker could get a week's support out of a day's pay. After several weeks' experience had demonstrated that, on this basis, it was possible only to work the mine on Mondays and close down for the balance of the week, the wages were cut in half. The result of this was work two days a week and idleness the other five. To make a long story short, several wage cuts were piled on top of the first, until finally the daily wage was precisely one-sixth of what it had been at first; and the entire force worked six days a week at this scale, with the utmost cheerfulness, because they had to do so to live.

Of course, the problem at the coal mines cannot be dealt with in any such arbitrary fashion at this. But the same principle underlies. The men must live; and the less work they get, the higher the rate they must receive for that work, in order that they may live. It invariably will follow that the higher the rate of pay, the less work they have to do to live, and the less work they can be made to do. Conversely, the more work they can be given, the lower will be the minimum living wage rate; and while it is neither possible nor desirable to cut the work in proportion to the increase in time, it could and would be materially cut, and the men would do more work at the lower rate. If the men can be given a fairly full week's work every week, there will be less heard about strikes for higher wages and the difficulties of getting a full week's work out of the men.

One of the first things that the coal operators would

want to know about Federal control would concern the controlling personnel. If Federal control of mines means, as in the case of the railroads, simply Federal backing behind the present management, so that experienced men may have full power to run the mines as they should be run for the fullest good of the nation, and to deal with the railroads on a footing of equality, well and good. But the operators insist that what they have seen of Federal control of coal is not like that. They fear the results of a change in policies and a change in management which might follow Federal control. Their point of view here is as follows:

Men would perhaps be placed in charge who would only be interested in getting an output as large as possible and as cheaply as possible. They would not, in many cases, be interested in the future of the mine; neither would they know how to safeguard that future. Some of them, perhaps selected for proven executive ability in other fields, would even understand nothing of mining. This would result in the most accessible and easily worked parts of the property being taken out. The pillars of coal left to support the roof would be hogged out; there would follow bad squeezes and falls from the roof, due to the weight of the rock above crushing the weakened supports. These squeezes or falls would necessitate the abandonment of large areas of coal, even perhaps of the mine itself. Of course all these fears may be grossly chimerical. But the operators can only judge Federal control of coal from what they have seen of Federal control of prices, and they do not find this parallel a comforting one. Further, as the mines are right now able to put out more coal than is required, it seems unnecessary that they should be operated under Federal control and be subjected to these accompanying dangers.

The Cost of Mining Coal

The operators are entirely clear that the fixing of prices that has been so far done by the Fuel Administration has been absolutely unfair and unreasonable, in that it fails to take into account that fundamental of all business—cost of production. The operators do not at all object to price regulation of itself; but they most emphatically object to regulation that discriminates against the mine which has a high cost of production, through no fault of its operators. And a dead level of price for the whole country of course does so discriminate.

The cost of mining coal depends upon a number of factors, which vary for different parts of the United States. These factors, with the limits within which they fluctuate, may be stated approximately as follows:

The thickness of the seam of coal is the first factor, as on this depends the general method used in operating the mine. This thickness varies from 18 inches in certain Kentucky and Missouri deposits to 12 or 14 feet in the Pittsburgh district and the Georges Creek region of Maryland and even to 100 feet in the anthracite beds of eastern Pennsylvania. It will be readily appreciated that it costs more to get a given quantity of coal out of a thin seam than out of a thick one. To mention the chief points, more digging and more miles of underground hauling are necessary, a greater area of roof has to be supported, and a different method of mining will have to be used—one taking a smaller bite from the vein.

Here we have the second factor. In some mines digging is done by hand, in others the coal is blasted out of the solid by the use of powder and in many other cases the very latest wrinkle is applied and the coal is cut out by a mining machine. Obviously this opens the door to further great variation in cost, which is with equal obviousness to a large degree outside the control of the operator, who has to use the method best suited to his property. The fact that coal can be mined more cheaply somewhere else by machinery does not by any means imply that Mr. Blank of Dashville can effect an economy by introducing it in his mine.

A third factor is the cost of haulage of coal within the mine. In some mines mules do all this work; in others

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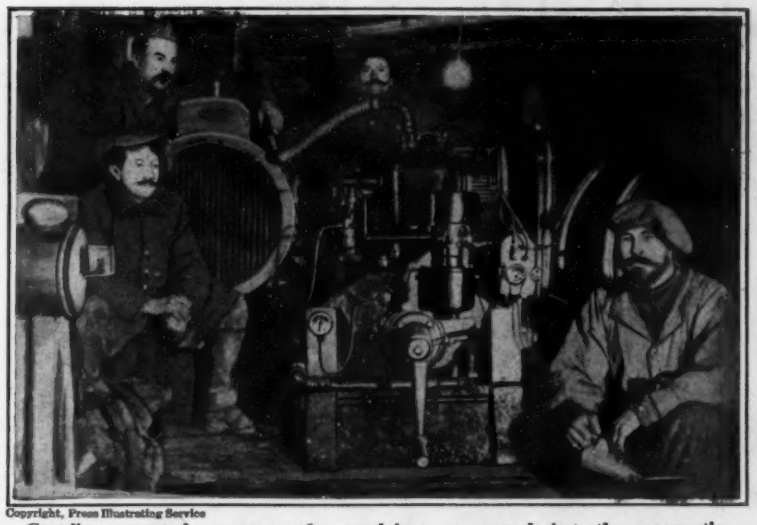


Gasoline-operated compressor for supplying compressed air to the pneumatic tools used by French sappers

Belgian soldier wearing the new type helmet for protecting the face

Furnishing Compressed Air to Military Miners

THE sapper of today no longer bores his way toward the enemy positions with pick and shovel and other hand tools. Instead, he employs pneumatic tools wherever possible, and does his work in much less time and with much less effort. Furthermore, speed is the very essence of success in mining operations. For both sides carry on mining operations and have expert "listeners" to detect when and where the enemy is driving a tunnel. It often becomes a race, with each side trying to prepare and detonate its mine first, before the work of many weeks or months may be destroyed and rendered useless by a countermine.

In the accompanying illustration appears a type of compressed-air plant employed by the French sappers. This plant comprises a gasoline engine, air compressor and the necessary appliances. The round object slightly to the left in the illustration is not a searchlight, as appearances would indicate, but the radiator for the engine. The drum at the right is the storage reservoir for compressed air.

A Helmet Which Protects the Fighter's Eyes

FIGHTING is becoming safer each day. Just now it is the shrapnel-proof helmet which is being improved upon so as to serve the further purpose of protecting the wearer's eyes and face, as well as the head.

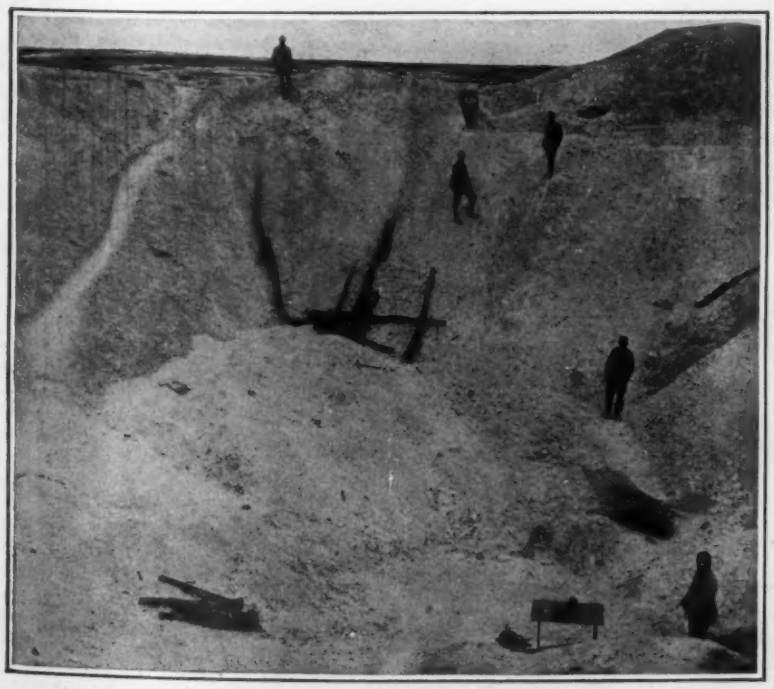
In the accompanying illustration appears the improved Belgian helmet. As will be noted, the Belgians have taken the well-known French *casque* and added a visor member extending well down over the face. This visor is provided with two openings or windows, each protected by steel bars running across, so that there is small chance of a shell splinter reaching the wearer's face.

It will be recalled that the newly designed Swiss helmet is also provided with a visor. As likely as not the visor will soon be a feature of most helmets.

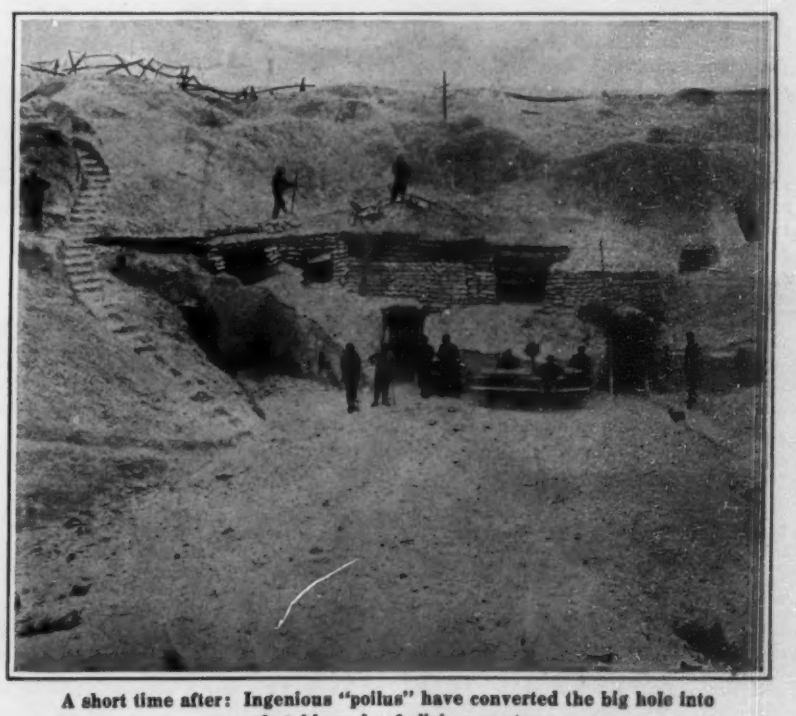
Making the Most of Mine Craters

THE sequel to any mine explosion is a big hole in the ground. On the fighting front in France are to be found man-made craters hundreds of feet wide and over one hundred feet deep, resulting from the discharge of tons of high explosive. Were this war not one of stationary character, were not the opposing soldiers always seeking cover, the mine craters would be more troublesome than useful. But in this war the mine crater has distinct advantages which are not overlooked.

Deep holes are the basis of underground works and shelters. If you have ever dug you can well imagine the joy of the soldier, be he enemy or friend, who finds much of the digging already done for him. So the soldiers make full use of mine craters, either as well organized defensive works or as underground quarters. In the accompanying illustrations we see first the mine crater resulting from the work of French sappers in the Somme section, and secondly, the same mine crater after its organization. The slope is honeycombed with shell-proof quarters for the men; stairs are hacked out of the chalk face at the left, and the rim of the crater is guarded by barbed-wire entanglements. Sandbags help make the underground shelters still safer.



Aftermath of a mine explosion: A deep mine crater in the Somme sector on the western front



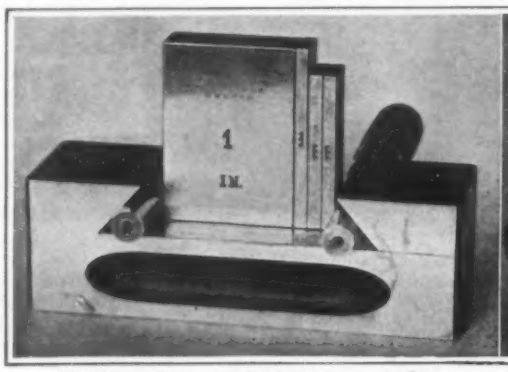
A short time after: Ingenious "poilus" have converted the big hole into comfortable and safe living quarters

The Fool-Proof Precision Gage

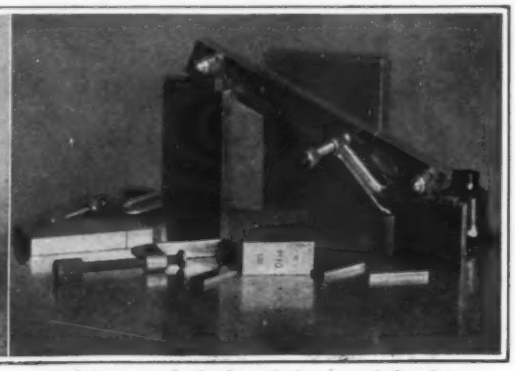
How the Results of Skilled Labor Are Made Available For Use by the Unskilled

THE United States will need enormous quantities of rifles, revolvers, cartridges, shrapnel shells, machine guns, motors, etc. How is a sufficient output to be obtained? An excessively large proportion of the work has to be done very accurately. This accentuates the problem, because it means that high quality must be combined with colossal production.

The time-fuse at the head of a shrapnel shell must fit closely and yet there must be no difficulty at all in screwing it into position. This part is put on at the front and not in the shop. Any time-fuse of a lot must fit any shell of a lot. If the fit is loose, if the threads jam so much of labor, material, transportation and volume of fire have been permanently squandered. We have here a fine example of what is meant among manufacturers by the term interchangeability. That it is a commercial possibility is demonstrated every time an artilleryman screws a fuse into place.



Testing a dove-tail slot by means of plugs and blocks



Arriving at a desired angle by use of sine-bar with precision blocks

Securing the proper fits, if that problem existed all alone, would present no wonderful difficulty. We have had such things in times gone by. A ship's chronometer is perhaps as good an example as any. Given skill and plenty of time, microscopic fits could be made in the old days. It did not necessarily require great precision in measurement. If the hole, slot or other opening were made with a tendency to undersize and the rod, feather or other co-acting part with a tendency to oversize, then the fit could be made by the use of the file, the emery wheel, the scraper and other tools. Each watch or other piece of mechanism could be made an example of wonderful perfection.

But the present day requirements, greatly accentuated by the necessities of the war, are bringing about a big change in manufacturing practice. The tendency now is to get away from the highly skilled mechanic who puts things together with the aid of judgment and acutely developed sight and touch, resorting to various fine cutting and scraping tools to produce the necessary fit. The modern ideal is to discard these methods and substitute parts made so accurately that the various fits are a matter of course.

America is up against the problem of creating an all-pervasive partnership between Quantity and Quality. Both are required. Happily, the United States is the home of interchangeability. It has been fostered by the needs of the user of machines and the desire to cut down costs. The American manufacturer has been in much the same situation as that in which the Government now finds itself. Consequently, the Government has the benefit of experience already gained. There is just one practical solution of the problem. That is to make the shop workers competent for their jobs without requiring high mechanical skill and experience. And this can be done.

Excessively precise dimensions are often demanded. A diameter must be, say, within 0.0001 inch of standard. This is a pretty small permissible variation, or tolerance, as it is technically known. A leaf of the SCIENTIFIC AMERICAN has a thickness 30 times as great. How is the common workman to machine the rod or other part to such perfection?

Modern measuring gages —particularly limit gages— will settle the matter quickly and decisively. He has at hand, say, a snap gage set to two dimensions. One is 0.0001 inch larger than the standard size required; the other is 0.0001 inch smaller. If the rod passes through the first, it is small enough; and if it refuses to pass through the second, it is big enough. All the workman has to do is to get this result of "go" and "not go." When it is attained, the piece is right, since it falls between the limits of +0.0001 and —0.0001 inch. The operator will neither know nor care just what small part of an inch of variation is permissible, or just what variation he has attained. But he will soon learn in a practical and convincing manner that when he has the rod down to a size nearly small enough to pass the wider opening, he may lose the game if he now takes off more than a merest trifle of metal.

A busy corner of a well-equipped testing room

The inspector follows the workman in measuring the piece. The latter may have forced the wider opening. The inspector checks up his measurement and detects this and other slips. His gage is not necessarily set to the same limit of variation as that of the workman. If plus or minus 0.0001 inch is really the thing wanted, then the operative's gage may be set a trifle closer and the inspector's at the required limits.

The man at the machine does not set his gage. It is set for him and then sealed against meddling. At night, all gages may be collected, to be distributed again in the morning. Where these customs are followed, the skill requisite to the setting is not demanded of the workman. He is not confused with decimal dimensions carried to the fourth place. He is divested of such responsibilities and confined strictly to machining to gage size. The skill required for setting need be possessed by but few men. The non-adjustable gage is the thing which enables that few to supply in effect the percentage of skill needed at every machine throughout the day—to put that skill at the disposal of all hands.

This possibility of quickly making, for the operation in hand, the equivalent of a highly skilled machinist out of the common run of workman, is the one thing that will enable Uncle Sam to get the Quality and Quantity which he must have. The plug gages, the snap gages, the ring gages—in short, the fixed gages—are in reality mighty factors in the present war. I ought perhaps to add to the company of fixed gages certain other gages which also do not call for judgment and skill on the part of the operator. The SCIENTIFIC AMERICAN has recently described, for example, a high precision gage which manifests microscopic variations in the work by large, visible fluctuations of a colored fluid in a tube. All such instruments may be set by the skilled man for the use of the unskilled.

The setting of the various gages is a matter of considerable interest. There is naturally a variety of types. There is the snap gage with its two openings. There is the plug gage for testing the diameter of holes. This may be single or double. The double plug gage consists of a rod or bar at whose ends are solid cylindrical plugs. The longer one must enter the hole; the shorter one must refuse to enter. The "go" plug is longer, not merely for identification, but because it has or may have duty of testing the hole throughout its depth. Then there are gages for testing screw threads, both external and internal.

There are several ways of setting a plug gage for diameter. One way, perhaps the most common, proceeds by the use of micrometer calipers. Another method makes use of small precision blocks of steel. These blocks or tablets are marvels of accurate workmanship. Each block will have at least two opposite faces flat and parallel to an extraordinary degree. The thickness between these faces is determined with equal accuracy; some will measure just 1, ½, ¼ inch or the like apart, within a very small error. In fact, these blocks (up to the 6-inch block) are guaranteed to have no error greater than 0.00001 inch. The paper on which the present article is printed is 300 times as thick as this minute interval.

With a complete set of such blocks, it is possible to build up a considerable variety of usual measurements and also a considerable variety of slight variations from the usual measurements. We may in this way build up the "not go" and also the "go" diameters. The errors in the blocks themselves are usually negligible. If we have only a few plug gages to test, we may use extension

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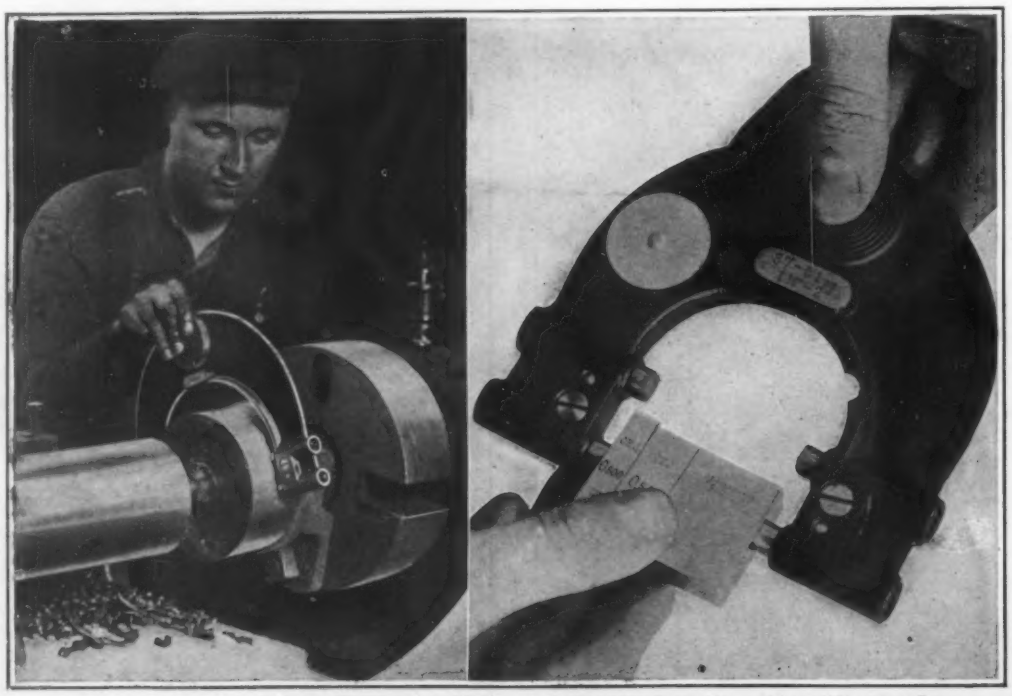
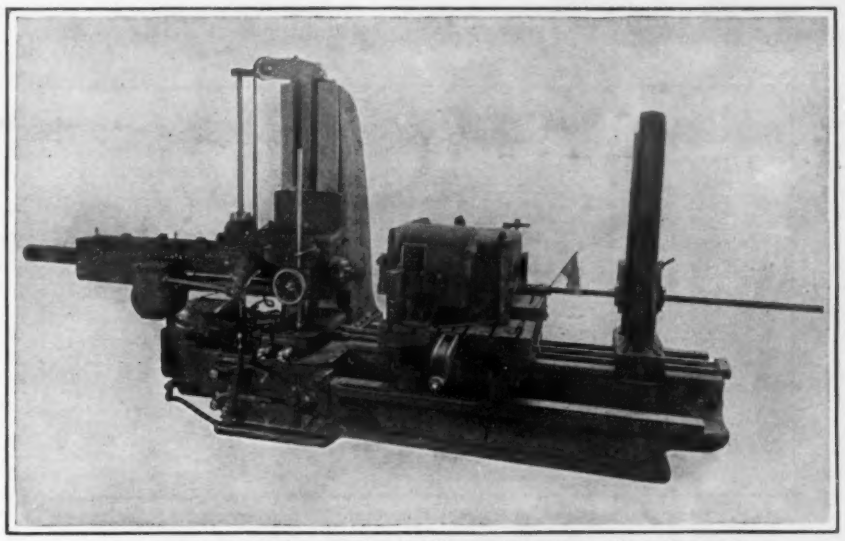


Testing a round bar with a snap-gage and (at the right) setting the wide opening of the gage by means of precision blocks

A Machine of All Work

WE have frequently referred in these columns to the fact that the latest developments in metal-working machinery are altogether in the direction of the all-around machine that performs a variety of operations upon a complicated piece of work and makes it unnecessary to adjust the piece in one machine after another. It is seldom possible to illustrate such a machine in a way which shall suggest anything more than a mountain of moving parts; so we are all the better pleased to be able to show the very excellent picture of a combined boring, milling, drilling and tapping machine recently brought out in Defiance, Ohio.

This machine, as will be seen from the cut, is so equipped with spindle, platen and saddle as to be able to execute, in any of the three directions, any of the operations for which it is designed. The feed is applied, by conical and helical gears, to the spindle in and out of the spindle head, up or down to the saddle, and across the saddle to the platen, with a convenient indexed lever to give the same feed wherever applied. Fast or slow travel to all parts having feed may be obtained at pleasure of the operator. All adjusting screws are provided with dials graduated to thousandths of an inch in order to facilitate the production of accurate work. Only eight levers are necessary for the complete operation of the machine, and these can all be reached by the operator without changing his stand. On the whole, this seems to be a most valuable contribution to the equipment of the machine shop.



The machine for boring, milling, drilling and tapping, with work set up

Calibrating and Straightening Machine for Gun Barrels

TO the mechanic's way of thinking, the manufacture of guns has always presented a certain humorous side. In the production of the various components extreme accuracy is exercised, and the work is checked up with a large array of delicate gages. But when it comes to the barrel—the very member above all others where accuracy is essential—the straightening of the bore is done with a sledge hammer and anvil, followed by a crude hand-operated press or so-called straightener; and the accuracy of the work is checked up with the eye. Highly paid men glance through the bore undergoing straightening, and wherever they detect a shadow they apply the aforesaid methods. Their word as to the straightness of the bore is final. All of which is quite ludicrous, to be sure; but for want of some better means this practice has continued in universal use.

By a simple electrical and mechanical arrangement Mr. Charles W. Sponsel of Hartford, Conn., has placed the straightening and checking of the bore on a par with other phases of high-grade gun production. For his machine, which is now offered to governments and manufacturers, can be operated even by an unskilled workman with mathematical precision. With one day's experience an unskilled workman can straighten barrels within a fraction of a thousandth of an inch, according to Mr. Sponsel. Never before have manufacturers been able to accept specifications calling for the bore of a barrel to be straight within .002 of an inch for its entire length. What is more, the machine permits this phase of the process to be expedited as never before, thus rounding out the quantity production methods throughout the processes of gun manufacture.

The principle of Mr. Sponsel's machine is quite simple, although its application is somewhat involved. It consists of a sensitive electrical apparatus for detecting any slight deviation from straightness in the bore, and means for applying pressure to the gun at the point of error so that a permanent "set" will be imparted to the metal at this point to bring the barrel into the desired alinement.

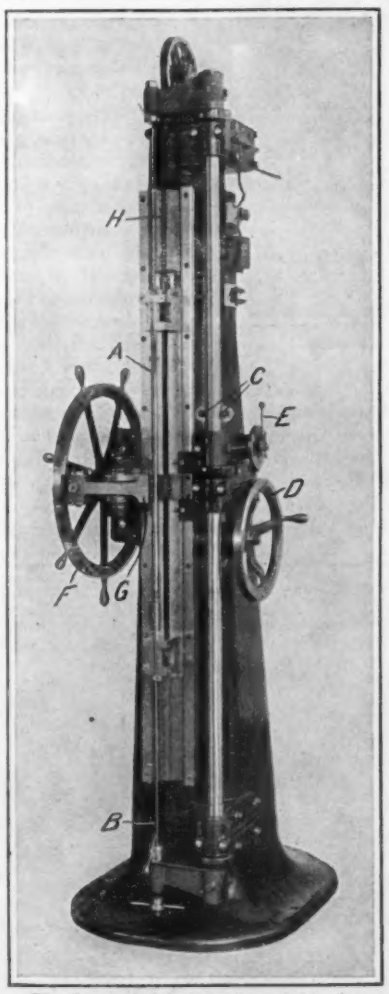
Referring to the accompanying illustration, it will be noted that the gun barrel *A* is placed in the machine and held by plugs carried by adjustable brackets. Stretched between the adjustable arms at the top and bottom of the stand is a taut wire *B*, hich passes through the bore of the barrel. A V-shaped platinum "feeler" is mounted on this wire and when it comes in contact with the inner surface of the barrel, one of the electric lights *C* is extinguished while the other burns full. Normally, the two lights burn with equal but dim intensity, being connected in series.

Now the platinum feeler is rigidly mounted on the wire, so that the barrel must be moved up and down in order to bring every part of the bore past that point. This is accomplished by the handwheel *D*, and the barrel carrying member is so delicately counterweighted through the chain *H* that the movement is smooth and positive. The position of the wire with relation to the bore can be varied by means of the lever *E*, which serves to twist the large vertical shaft which in turn moves the arms at top and bottom between which the wire is stretched. The shaft is supported on ball bearings, and the lever, operating a screw, completes this delicate arrangement which moves the wire toward or away from the column of the machine. The platinum feeler has its knife edge always pointing toward the column.

In operating the machine the wire is moved until the feeler is almost in contact with the barrel. Then, while the two lights are dimly burning, the barrel is moved up and down the wire by means of handwheel *D* in order to traverse past the feeler. If the lights show no sign of contact, the feeler is brought still closer to the inner barrel wall by means of lever *E*. The distance of the feeler from the barrel wall is indicated by a micrometer dial carried on the screw which is turned by lever *E*. This screw has 20 threads per inch, and the dial is divided into 50 spaces, each of which corresponds to 0.001 inch. At each side of the zero point two spaces are graduated to 0.00025 inch. The process of moving the wire nearer is continued until one of the lights is extinguished, indicating a "high spot."

The straightening operation consists simply of applying pressure at the point where it is needed. This is done by turning handwheel *F*, which in turn forces the hammer *G* down onto the front of the barrel, this hammer being located opposite an anvil with two supporting points on which the gun is held from the back. During this operation the feeler is located midway between the two supporting points, so that the lights indicate when the high spot has been removed.

In reality, the new machine comprises six machines in one, capable of insuring accurate results in the performance of the following operations: Measurement of the bore, straightening of the bore, determination of reamer pockets, determination of eccentricity of outside of barrel to bore, location of sighting marks, and measurement and straightening of bore after rifling. The machine is adapted for use on rifle, shotgun and machine-gun barrels.



The last word in barrel straightening is this machine

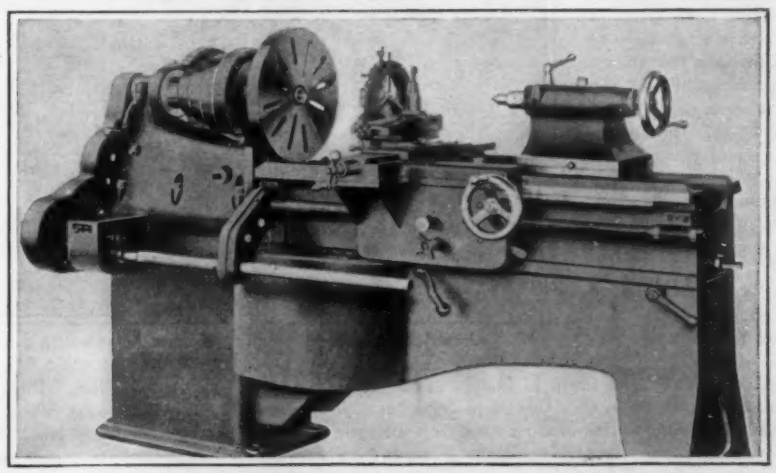
A Combination Lathe, Boring and Milling Machine

THERE are certain advantages in combining several machines into one, especially if the combination equipment can do each kind of work just as efficiently as the former machine built solely for that purpose. In other words, there is little gained in devising a makeshift which will do only one thing well and the others half well or not well at all. A true combination must result to be successful.

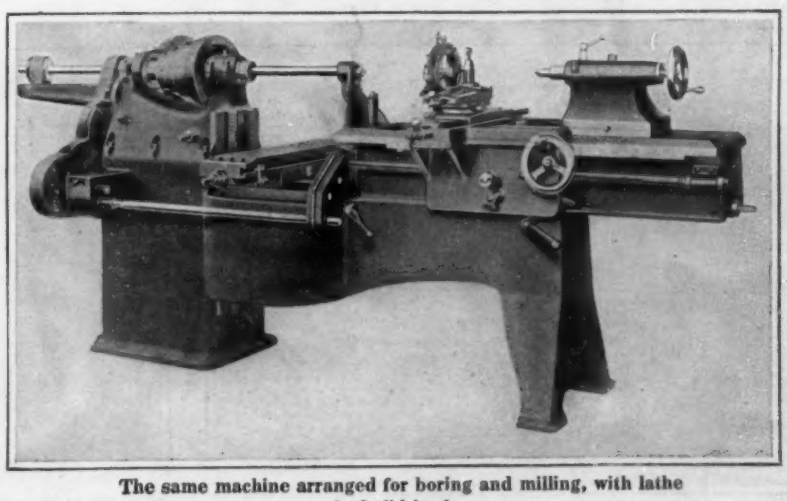
It has remained for George W. Fleming of Springfield, Mass., to work out a combination machine which incorporates all the facilities of a 16-inch engine lathe, horizontal boring mill, and a plain milling machine, with the additional feature of sliding bed gap lathe. Each unit is as complete and distinct as the same machine individually constructed, and gives the same range and capacity; for it will be noted that Mr. Fleming's machine has been thoughtfully designed and is in no sense of the word a makeshift or improvision.

The accompanying illustrations present the machine arranged for boring and milling, and as a 16-inch lathe. The base carrying the sliding member is strongly ribbed and supports the lathe bed without vibra-

(Concluded on page 468)



Newly-invented combination machine arranged as a 16-inch lathe



The same machine arranged for boring and milling, with lathe bed slid back

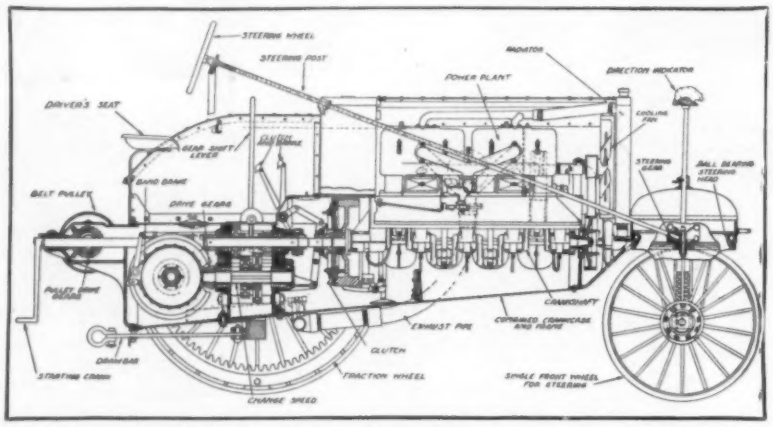
The Motor-Driven Commercial Vehicle

Conducted by VICTOR W. PAGÉ, M.S.A.E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Distinctive Agricultural Tractor Design

TRACTOR designers are gradually departing from their preconceived notion that an agricultural tractor must be based on the same engineering lines as the steam roller and that crudity in construction is unavoidable on account of the nature of the work which the tractors are called upon to do. At the present time tractor design has changed and many machines are now being built that have features similar to those found practical by years of service in automobile practice. The tractor illustrated has a layout of power plant, clutch and power transmission mechanism that is very similar to that ordinarily incorporated in motor car construction. Its outstanding feature is a unit frame construction by which a substantial underpan forms more than one-half of the engine crank case and almost the whole of the clutch, change speed gearing and final drive housing. This frame structure is made from a boiler plate bent into suitable shape and having fittings riveted to it by which the front wheel, which is used for steering, is supported. This construction provides a strong and rigid frame and at the same time the weight is not excessive. The advantages of the unit power plant with its almost perfect alignment of parts is of course secured by this construction.



Unconventional agricultural tractor incorporating good engineering features in combined power plant and frame

The power plant of this tractor is a 4-cylinder T-head motor having the cylinders cast in pairs and bolted to a cast iron crank case. This member is of unconventional form because the joints between the cast iron and steel portions come some distance above the crank shaft center line. The crankshaft main bearings are attached to the top part of the crank case. The cylinders are of 6-inch bore and the pistons have a stroke of 7 inches. The engine develops 52 brake horse-power at 650 crank shaft turns and as will be observed the crankshaft is very securely supported by substantial bearings which are adjustable to compensate for wear. The clutch is a three-plate type which transmits the engine power to a simple sliding gear transmission, giving two forward speeds. The main shaft of the transmission is extended to the rear end of the tractor and drives a belt pulley through bevel gearing, this permitting the engine to be used as a stationary power plant. The countershaft of the transmission gear has a bevel pinion carried on the end, which meshes with the large ring gear attached to the differential mechanism. The final drive consists of the usual bull pinion and internal gear secured to the wheel rim.

The tractor is easily controlled, the general scheme being similar to that of a motor car. The wheel steering gear extends to the front of the tractor and turns the front wheel around through the medium of bevel gears and a chain running around a sheave attached to one of the gears and passing around the ball-bearing turn table or steering head which is made integral with the forks supporting the front wheel. The clutch is actuated by a pedal as in automobile practice and the powerful external constricting band brakes which act on the differential housings are also actuated by a pedal similar to that used to control the clutch. The gears are shifted by a simple hand lever. The relation of the various units to each other can be readily ascertained by inspecting the design drawing which clearly shows how thoroughly all working parts are encased so that they will be protected from dirt and grit and be assured of adequate quantities of clean lubricant.

American-Built Military Roads in France

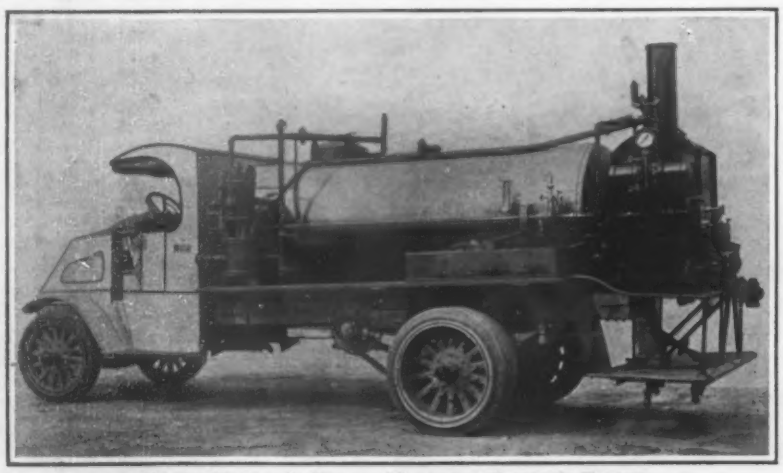
WHEN the complete history of this war has been written, it will be more fully realized what a vital part good roads have played in the great struggle. At the start, motor trucks leaped to the front as the modern pacemaker of flexible transportation, and ever-increasing war needs have demanded new roads and better roads as most necessary for the proper backing up of fighting forces. Motor trucks by the thousands will contribute an enormous advantage to United States road engineers engaged in new construction back of our lines. It is estimated that 1,200 miles of highways will be built in 1918 by American road engineers in the rear of the firing line in France. To the special road building battalions is delegated the important task of keeping lines of communication constantly open, and powerful trucks working in conjunction with modern American road machinery, will help to build new strategic lines and keep communicating roads in constant repair. The road building fleet will be composed of several thousand dump trucks, hot road oilers, pressure sprinklers for making water-bound macadam, gasoline tank trucks, printing press trucks for printing blue prints, instructions, plans, reports, etc., machine shop trucks, blacksmith and tool repairing trucks.

American engineers treating a French road with a hot road-oiler

Although France is particularly well endowed with good roads, it is often necessary for military reasons to construct new lines. An estimate places the present mileage of French roads at one mile of road for each one and one-half square miles of ground surface. The tremendous task of keeping these roads in perfect condition and building new ones at the same time, can well be imagined when it is realized that so far as wear and tear are concerned war traffic is ten times as great as that on Fifth Avenue, New York.

Most of the roads of France are built of water-bound macadam. The peculiar nature of the French soil, which is of limestone formation, lends itself readily to compaction under the road roller and makes a very good road building material, although it requires constant maintenance. The British, however, introduced the tarred surface road and an increasing mileage of that type is found back of the British lines. One of the principal objections to the water-bound macadam road near the front is the dust which rises from it in dry weather under heavy war traffic. Clouds of dust draw artillery fire from the enemy, and for this reason U. S. Engineers, in planning road construction and maintenance near the American front, will probably utilize large quantities of tar coating which is freely obtainable in France.

Of course the pressing object of American road construction is to provide for the immediate needs of our forces, but the work carries with it both utilitarian and historic value. When Ceasar's legions poured through Gaul and into Britain and returned to Rome again, they left in their wake military roads so carefully constructed that many sections remain today as permanent monuments of their presence. American system and modern methods likewise promise to contribute many enduring benefits to France. Our road building battalions are going about their work scientifically and with an object fully as far-reaching as the work of Ceasar. All is not destruction that comes out of war, and many American built highways should remain to become of immeasurable value to France in conducting her commercial and social intercourse. But the path of the military road-maker is not strewn with roses. The oscillations of the battle-line back and forth keep him building the same roads over and over again. The chief aim of the enemy artillery seems, too, to be the provision of work for him. And normal wear and tear is something incredible.



Type of hot road-oiler used by our engineers in France

Truck with dumping body used by our road building battalions

RECENTLY PATENTED INVENTIONS

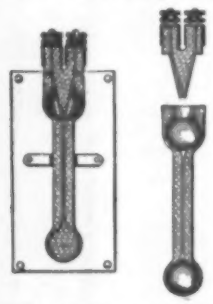
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

SHOE HEEL.—E. S. HELWITZ, 1129 E. 15th St., Brooklyn, N. Y. The invention relates to detachable rubber heels. The object is to insure that the rubber heel be securely fastened to the leather heel yet be easily attached and detached so that it may be used in connection with one or more pairs of shoes. It is especially adapted to use with what is known as French heels, however, it may be used with so called Cuban heels, and ordinary heels of men's shoes.

Electrical Devices

THERMO ELECTRIC FIRE ALARM SYSTEM.—A. M. DE SILVA GREAVES, P. O. BOX, 1707, Boston, Mass. The object of the invention is to provide a circuit closer which is simple and reliable in construction, which permits of the free expansion of the mercury beyond the point at which the circuit closing action is effected at the



SECTIONAL VIEWS OF THE DEVICE

desired temperature, thus ensuring a positive connection of the circuit terminals by the mercury to close the circuit. A further object is to adjustably mount the terminals so that they may be projected into the expansion chambers to a greater or less extent thereby varying the time at which the alarm is energized.

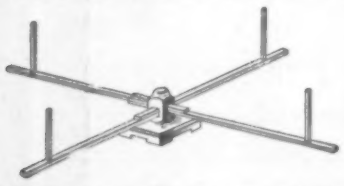
Of Interest to Farmers

DITCHING MACHINE.—T. J. JOYNER, 14 3d Ave., South, St. Cloud, Minn. The object of the invention is to provide a ditching machine wherein sectional tracks are provided, mounted on suitable wheels for supporting and laying the same on opposite sides of the ditch to support the ditching machine between the said tracks and wheels.

Of General Interest

DUPLICATE SALES BOOK.—A. GREENSTEIN, care of Oppenheim Collins Co., 33 W. 34th St., New York. This invention relates to duplicate sales checks and tags, the device comprises a pair of thin and thick leaves, the thin leaves being for office files and the thick for delivery use, the thick leaf being adapted to receive a written carbon impression from the thin leaf, the said leaves being provided in the book with registering holes of equal size, said holes in the thick leaves being for the application of wrapping cord.

KNOCKDOWN YARN REEL.—E. C. PALMER, 27 Bay St., Glens Falls, N. Y. The invention relates to knock-down reels, more particularly to a type of yarn reel in which pairs of radial arms are slidably adjustable in a head rotatable on a suitable base. The rotatable head



PERSPECTIVE VIEW, SHOWING DEVICE SET UP FOR USE

has two communicating mortises arranged transversely, and at different levels the arms are received in each mortice, a wedge is receivable in the mortise for clamping the arms adjustably in the head.

PAPER ROLL RACK.—F. and F. T. WINTERHALTER, 308 Chapel Ave., Jersey City, N. J. An object of the invention is to provide a simple strong and inexpensive rack which will always present a portion of the paper from the roll ahead of the cutting knife, thus obviating the necessity of manipulating the roll of paper when paper is to be drawn from the roll. Another object is to provide a rack having feeding rollers whereby any desired quantity of paper may be fed from the rack without pulling on the end extending in front of the cutter.

PACKING.—W. A. YOUNG, 198 11th Ave., Long Island City, N. Y. The object is to provide a readily removable packing for heavy shells, this packing is formed from loose fiber which is twisted to form a wisp-like structure which when permitted recoils upon itself to form a crude rope, the ends of which are bent to form loops. The free ends of the strand meet adjacent the center, the device being placed under the shell so that the shell rests on the body portion, the loops are lashed until the lashing is equal in thickness to the body, by cutting the lashings only, the loops can be repeatedly used.

SCALING AND ANNEALING OF METAL ARTICLES.—F. PERRY, Tipton, England. The invention relates to a process for annealing metal articles, which consists in introducing into the oven containing the articles, Mond gas purified by removing the saturated hydrocarbons such as methane in addition to such deleterious constituents as excess water, vapor, sulfur compounds, and unsaturated hydrocarbons, and passing such gas prior to its enterance to the muffle containing the metal articles, over iron at a temperature of about 250 degrees C.

MUSIC FILING CABINET.—P. T. LARKIN, 16 Elm St., Great Barrington, Mass. The object of this invention is to provide a music filing cabinet especially designed for conveniently filing sheet and roll music and phonographic disk records and phonographic cylinder records and arranged to permit the user to quickly locate and easily remove any one piece of music without disturbing any other piece.

SHAVING BRUSH.—W. L. BRYANT and E. C. LUNING, address William L. Bryant, Vaughn, Wash. The invention relates generally to shaving brushes, but more particularly to reservoir brushes having means to retain a quantity of shaving soap in plastic form, together with adjustable means for feeding the same to the brush, including means whereby to effectively cut off the feed when the brush is in use.

TAG HOLDER.—S. J. AGNEW, 729 E. St. San Diego, Cal. This invention is characterized by a blank which is shaped and bent to receive and present a tag on the front edge of a shelf and

A PERSPECTIVE VIEW OF HOLDER WHEN SECURED IN FRONT OF SHELF

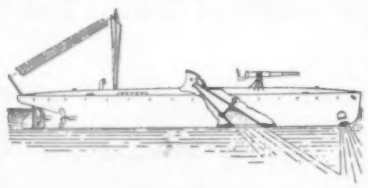
has a keyhole stamped therein whereby it may be easily and quickly attached to, or detached from, a pin provided for the tag holder in a shelf on which merchandise is to be displayed.

NON-REFILLABLE BOTTLE.—C. A. FOLLY, Boonton, N. J. The invention relates to bottle closures, and particularly to what is commonly known as a non-refillable bottle, the object is to provide a simple, strong construction which utilizes the principle of air displacement in its construction whereby refilling is positively prevented. Another object is to provide a strong construction with a minimum number of parts, readily permitting the removal of the contents while preventing the escape of air when refilling by reason of the pressure of the air, and preventing the use of a suction pump and the forcing of fluid into the bottle after a partial vacuum has been secured.

CLOTHES PIN.—R. H. GWINNER, 328 Cross St., Akron, Ohio. With this construction the clothes pin may be used to grip the clothes below the clothes line, the device having a looped portion and parallel arms extending therefrom for gripping the clothes, while the loop rests upon the line, or if desired the pin may be employed to press the clothes against the clothes line wither from above or below.

CINEMATOGRAPH APPARATUS.—G. W. COOPER, London, England. The invention has special reference to apparatus employed for taking pictures suitable for use with stereoscopic flickerless projection apparatus, the apparatus comprises a pair of lenses whether simple or compound which are movable relatively to one another while their axes remain parallel. In this manner it is possible to obtain identical images upon the films while every part of each of such images will be in focus and a stereoscopic effect produced.

SUBMARINE-CHASER.—A. EGENES, P. O. Box, 143 Lovelock, Nev An object of the invention is to provide a vessel of light draft and great speed which is provided at the bow with a powerful electric subsea search light for illuminating the water where submarines are liable to be found, and which is also provided with an observation or viewing tube and lens for observing objects under-



A SIDE VIEW OF THE VESSEL; PART BROKEN AWAY VIEWING TUBE BEING SHOWN

neath the water. A further object is to provide a device having a central observation tube into which the water may enter up to a certain point, with means for withdrawing the air to permit the water to enter, while preventing the water entering the boat. The vessel is equipped with guns and wireless telegraph outfit, a special telescope and other necessary optical apparatus for navigation.

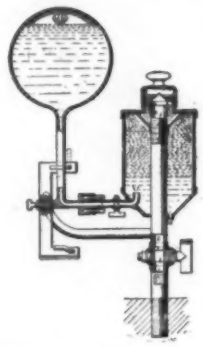
REPRODUCTION OR IMITATION OF OIL PAINTINGS AND OTHER PICTURES.—R. SAUBER, London, England. The main object of the invention is to produce a matrix which will permit of obtaining a die in which all the relief and depression marks, the impasto, expression of touch, and other characteristics of the surface of an original painting are produced, this object is attained according to the present invention by producing the matrix by means of two or more paints of different color, preferably black and white, in contradistinction to the one single paint hitherto employed.

Hardware and Tools

WRENCH.—H. V. HUGHES, Miami, Ariz. The invention relates particularly to wrenches of the S-shape type, its object is to provide a strong anu durable wrench, and which is operable without a thread and screw, may be quickly adjusted to different size nuts without the necessity of the mechanic using both hands to obtain this adjustment.

Machines and Mechanical Devices

OIL CUP AND FEEDING ATTACHMENT THEREFOR.—J. H. METHVEN, Box 171, Ronald, Washington. The invention relates generally to oil feeding devices, and more particularly to oil cups and attachments, the combined operation of which effectively prevents



VIEW, PARTLY SIDE ELEVATION AND PARTLY IN SECTION

the feeding of impurities with the lubricant, and the construction of which obviates clogging up of the feed pipe by impurities in the oil within the the cup.

MIXER.—C. H. STROUP, 242 Union St., Johnstown, Pa. The object of the invention is to provide a mixer adapted to mix various materials either hot or cold. The mixer is constructed with a flue below its mixing pan which leads from a melting pan in which the material may be heated or melted before it is deposited in the mixing pan, the material being kept at the desired temperature while it is mixed by paddles, which rotate downwardly and inwardly at the sides of a spiral conveyer which assists in keeping the material in constant motion.

COMBINED WASHING MACHINE AND WRINGER.—C. JOHNSON, 420 Dayman St., Long Beach, Cal. An object of the invention is to provide a wire clothes basket, revolubly mounted, in which the clothes may be placed and the machine operated to effect the washing by a pounder, the two being adapted to be operated relatively to each other, and whereby after draining off the water, to permit the washing means being thrown out of operation, and the clothes basket given rotary movement to effect the wringing of the clothes by centrifugal action.

Medical Devices

MEANS FOR ATTACHING AN ARTIFICIAL TOOTH TO A BACKING OR BRIDGE PLATE.—H. D. MORGAN, 115 W. Federal St., Youngstown, Ohio. The object of the invention is to provide an artificial tooth with pins having heads the sides of which diverge outwardly, the pins being adapted to be disposed in slots in the backing or bridge plate, the sides of the slots converging from the cutting edge of the backing, and being under-cut to permit the insertion of the heads of the pins in the slots adjacent the cutting edge and the movement of the artificial tooth into place, the heads of the pins being wedged.

SURGICAL INSTRUMENT.—A. BURSELL, 1211 West 59th St., Los Angeles, Cal. The object of the invention is to provide an instrument especially adapted for forming needles into curved or angular shape or for straightening the curving needles. The device consists of forceps, the inner face of the jaw of one member having a V-shaped groove extending longitudinally thereof and gradually decreasing in depth toward its inner face, the other jaw being cut away at each side edge to fit the groove

Prime Movers and Their Accessories

CARBURETER.—L. J. JORET, Paris, France. In ordinary carbureters the fuel provided by the spraying nozzle is generally only drawn along by the current of air sucked in. In the present invention the arrangement of carbureter is combined in such manner as to utilize the effect of weight to contribute to bring the fuel which would not have been volatilized at its exit from the spraying nozzle, to a conveniently chosen point where the air sucked in by the motor under low depression will be obliged to pass when the throttle valve is slightly opened, in such manner that this fuel is immediately atomized by the very rapid passing of this air.

Pertaining to Recreation

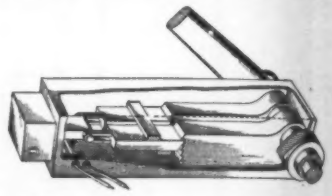
RIGHT TRIANGLE PUZZLE.—J. H. COYLE, care of Mrs. Hasett, 405 Charlotte Place, Glendale, L. I., N. Y. Among the objects of the invention is to provide a puzzle comprising a frame or holder and a series of blocks adapted to be assembled in a certain order of arrangement so as to fill the frame. The object of the puzzle is to so arrange all the blocks that they can be placed in the holder without crowding; the parts are so designed and proportioned that it is possible to substantilaly fill the holder or frame and yet leave one block unplaced, all of the space apparently being filled, while with different systems of arrangement all of the same blocks may be inserted.

Pertaining to Vehicles

SHOCK ABSORBER.—J. H. DONAHOO, 770 Liberty Ave., Beaumont, Texas. The object of the invention is to provide a device adapted for use with vehicles of every kind, to be arranged between the two elements to be cushioned. The device comprises a casing for containing oil, and is adapted for connection with one of the elements and a piston movable in the cylinder and adpated for connection with the other element and having a restricted port for the passage of the oil, the port being adjustable in capacity to provide for variations in resiliency.

SPRING WHEEL.—A. H. DONNALLY, Fairmont, W. Va. The invention relates particularly to a wheel having an arrangement of springs beneath a solid, resilient tire. The springs are enclosed at the sides by annular plates which are secured to the felly of the wheel by bolts, the edge of each side plate is inturned laterally to present flanges that overlap the side flanges on the tire. The cushion tire has an annular groove, in which an expansion ring is received the ring being of flexible material harder than the tire.

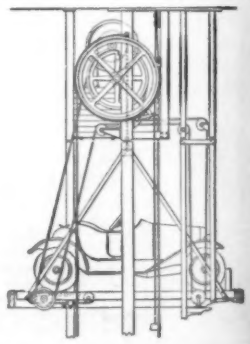
AUTOMOBILE LOCK.—E. C. LAMPSON, Jefferson, Ohio. The invention relates to a simple means for preventing the operation of an automobile by an unauthorized person through the combination of parts with locking means in such a manner as to hold inoperative the clutch pedal control shaft or sleeve. The construction



A PERSPECTIVE VIEW, WITH CASING PARTLY BROKEN AWAY TO SHOW DETAILS

is such at either clutch or service brakes may be locked independently or at the same time, the device prevents the car from being pushed or dragged away. The device may be used in many forms, and positioned in any convenient place on the car, it is applicable to practically any type of car manufactured.

AUTOMOBILE ELEVATOR.—J. O. VOGEL, 4040 Penn Ave., Pittsburgh, Pa. The prime object of the invention is to provide means on the elevator adapted to be brought into driving engagement with the driven wheel of the automobile by the running of the latter onto the



SIDE ELEVATION PARTS BEING BROKEN OUT, AND PART SHOWN IN SECTION

elevator platform and thereby causing the elevator to ascend with the automobile thereon by power derived from the latter. The device is subject to the brake-control of the automobile in the descent of the elevator with the automobile thereon.

SPRING WHEEL.—W. H. MCQUEEN, address W. H. Parker, Greenville, Miss. The invention provides for wheels including a felly having a solid tire, and a hub, together with a plurality of spokes, each of which extends in one piece entirely across the wheel, and has loose bearings at its ends in connection with the felly, and is

SIDE ELEVATION OF THE INVENTION

further provided with an intermediate bearing upon the hub, the spokes being extended tangentially with respect to the hub and crossing one another angularly between the hub and the felly, whereby to flexibly suspend the hub in a degree of elasticity dependent upon the gage of the spokes.

Designs

DESIGN FOR A WATER COIL.—C. G. TREFETHEN, 4 Porter St., Taunton, Mass. This design shows an oblong coil of straight members presenting parallel side tubes, and cross tubes at right angles to the side tubes, and intermediate oblong tubes.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Heading Rivets with a Hydraulic Riveter

THE rivets used to secure the plates of our standardized ships are headed by pneumatic riveters of the type familiar to any one who has witnessed the construction of a steel building. We are not so familiar, in this country, with the hydraulic method of heading rivets. Our British cousins use the hydraulic riveter to a considerable extent in their shipyards. This machine consists of a pair of jaws hinged together at the middle and provided with a hydraulic cylinder at the upper end, in which water is admitted to exert a pressure on the jaws and close them on the rivet. The advantage of the hydraulic riveter lies in the fact that a tremendous pressure can be exerted upon the rivet which will head it at a single operation. The rivet does not need to be hammered, but is pressed into shape. This results in a very tight rivet. Of course, the hydraulic riveter cannot be used in every position, and it must be supplemented by the use of the pneumatic riveter.

Our cover illustration shows the hydraulic machine in service, and it will be noted that it is suspended from a crane. One of the huge jaws is on the inner side of the ship plating and bears against the head of the rivet, while a cupped tool pressed by the jaw on the outer side of the plating forms a head on the projecting shank of the rivet.

We use hydraulic riveters in this country to a large extent in locomotive work. Some of our large riveters have a 17-foot gap from the hinge to the ends of the jaws, so that they span a structure of that depth. These giant riveters exert a pressure of a hundred tons on the rivet, and are supplied in the hydraulic cylinder with water at a pressure of 1,500 pounds per square inch.

The Current Supplement

THE suggestion that we eat whale meat as a desirable addition to our food supplies has already been given considerable publicity, but additional information of the subject will be found in the article on *Ocean Venison*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2211, for May 18th, which is accompanied by a number of excellent photographs. We do not eat whale meat now because "we never have eaten it," but it has much to recommend it besides its anticipated cheapness, for it is wholesome and a desirable addition to our really limited bill of fare. Moreover, the whale is a cleanly and a dainty feeder, which is more than can be said of many things we generally approve of, such as crabs, lobsters, eels and many fish and animals. Another instalment of the valuable articles on *Anomalies of the Animal World*, fully illustrated, appears in this issue; also the second lecture on *Problems of Atomic Structure*, by Professor Thomson. The lecture on *The Salvage of U-Boat Victims* is concluded. An interesting discussion on what becomes of the heat radiated by the Sun will be found in an article entitled *The Ether Ball. Increasing the Evaporation of Steam Boilers* sets forth some important researches on a new thermal principle in the boiling of water. If we could predict the weather for even a month in advance it would be a matter of the greatest importance to many pursuits and enterprises. Many people, however, believe that weather conditions repeat themselves in fairly regular cycles, which would enable fairly accurate predictions to be made for a number of years ahead. Some investigations of the subject will be found in the paper on *Long Range Temperature Forecasts*. Other articles in this issue include *Waste Land and Agriculture* and *Problems Bearing on Residual Affinity.*

Reconstructing the War's Maimed

(*Concluded from page 450*)

sitting down on the leg and walking. In the case of below-knee amputations the weight is carried, when possible, partially on the end of the stump and partially on the bones of the knee.

After the man's stump has been fitted into the rough leg, the patient wears his new limb around the hospital until it has become quite comfortable, trimming being done on the inside to remove unevennesses as suggested by the patient.

As soon as comfort is attained the limb is hollowed out as thin as possible and wet raw-hide is drawn tightly over the outside and attached to the wood with glue. This, when hardened, protects the limb from splitting, and strengthens the leg so that instances have been known where the wood has been badly shattered and the limb still retained its shape. A coat of paint finishes the exterior, and the interior is surfaced with a high grade, shiny wood oil varnish, the most resistant varnish material known.

Boots to fit the artificial feet are made in the branch of the factory devoted to orthopedic shoemaking. A man who has devoted a life-time of study to the making of orthopedic shoes is in charge of this branch, and the surgeons refer many cases of fallen arch and other foot deformities to him for treatment.

It has been found that a man wearing one artificial leg places such a great strain on the other, especially in the early stages, that a special shoe is required. The patients are measured and fitted with boots designed to prevent weakness developing in the one good foot remaining. Every upper is fitted.

It should be understood that many different kinds of artificial arms are made, both in Canada and in the United States, under patent protection. The government of Canada has access to all patents, and no better arm is being turned out anywhere than that with which the Commission is equipping its returned soldier patients. At the same time every effort is being bent to the perfection of new ideas which might improve upon existing features of the limbs turned out by any and every factory.

While the soldiers requiring artificial limbs are still in the care of the Military Hospitals Commission Command, their needs in this respect are automatically taken care of by the hospital authorities. The after discharge needs are also provided for. In addition to the branch factory opened in Winnipeg several other branches will be opened in a half dozen or more central points throughout the country, so that breakages in artificial limbs supplied by the Military Hospitals Commission will be repaired and new limbs issued, as required, free of cost to the soldier so long as he lives.

Men who have incurred disabilities in army service which require appliances such as orthopedic shoes, trusses, spectacles, rubber bandages and belts, will have such an annual credit established with the Board of Pension Commissioners as the Military Hospitals Commission estimates will cover the annual cost of such appliances purchased in the open market. The man is notified that he may purchase appliances to the amount of the credit where he chooses and render accounts to the Board, the latter, however, reserving to itself the right to refuse to permit the use of appliances which have been found to be unsatisfactory. At the end of the year any balance remaining in the hands of the Board will be remitted to the man himself.

The artificial limbs and their repairs will be taken care of in the government's factories, but with minor appliances this arrangement is thought to be the most satisfactory both to the men and to the government.

In the factory several returned soldiers are being taught various branches of the art of making artificial limbs and orthopedic shoes, in order that soldiers sent to the factory may have the utmost confidence that men who have themselves gone through their experience are ministering to them.

Mining Australian Lignite With Steam Shovels

AT Morewell, Australia, there are extensive deposits of brown coal. The veins are said to run from 150 to 200 feet in thickness. It is claimed that motor spirit, benzine, illuminating oil, paraffin, and other by-products could be profitably extracted. At present it costs about $1.92 per ton to mine the coal, but an interested American claims, that with steam shovels, the coal could be mined at 12 cents per ton.

Seeing But Not Seen

(*Concluded from page 451*)

not be the case in actual practice. The robes are provided with porous helmets for breathing, and holes for the eyes.

A new class of camoufleurs has been formed to take care of the surplus aspirants who could not be accommodated in the 1st and 2d platoons.

More recently the New York camoufleurs have started work on trenches and field works in the vicinity of Yonkers, where they are obtaining first-hand experience in the camouflaging of things military under more realistic conditions Thus they are able to apply their experience gained with model landscapes to the real thing outdoors.

Not to be outdone by the young men, the Women's Reserve Camouflage Corps of the National League for Women's Service was formed some time ago, and these young New York ladies are becoming quite adept in the new art. In fact, it is said that they excel the young men when it comes to the matter of camouflage robes, for they are naturally more skilled with the needle and can therefore make better robes. Several days a week they work outdoors, learning as they go the secrets of the art of deception as practised on the battlefields of Europe.

The Port of Providence

(*Concluded from page 453*)

of the quay, including a high bluff with its many attractive summer cottages. The houses are disappearing, the hill has been eaten away by huge steam shovels, affording a long and wide level stretch on which is being erected a large boiler shop for the Fore River Shipbuilding Company of Quincy, Mass. Here that company will make boilers for the warships it fabricates at Quincy. The Government will expend $1,000,000 on this work and make it of so permanent a character that the property will be of use for commercial purposes when the war is over.

Incidentally, it might be remarked that work on the Field's Point improvement was begun on June 26th, 1912. There were 68,300 cubic yards of stone laid, 220,000 cubic yards of dredging done, 140,000 cubic yards of gravel placed back of the wall, 7,600 cubic yards of riprap, 394 piles driven under the wall, 294 more set as fenders and 75 others for trestles.

The State Pier No. 1 is 600 feet long, 120 feet wide and has a two-story steel pier shed 400 by 110 feet.

Now this is all quite a far cry from the subject mentioned in the opening paragraph of this article—Providence as a great oil distributing port; but it is a fitting prelude to a good story which in part antedates the harbor improvements, and in part relates to the future.

About thirty-five years ago the Standard Oil Company erected a longitudinal tank alongside the railroad bed of Providence, into which it pumped oil from tank cars. The oil was coopered there and delivered to jobbers who supplied the wholesalers and retailers. In 1888 the company established its first delivery wagon, the orders being solicited by a single salesman who visited the stores. The delivery wagon followed him the next day or so, and filled the tanks in the shops of the retailers. This did away with the cost of coopering, and it also rid the storekeepers of the nuisance of empty barrels about their premises and in their backyards.

May 5th, 1888, saw the Standard Oil Company establish its first tidewater station in Providence Harbor. It secured what was considered a perfectly useless and therefore almost worthless strip of swampy land on the east side of the Seekonk River, south of the Red bridge. The waterfront privilege was taken full advantage of, a wharf being built out to the harbor line, and the first line of big tanks was set up.

From that small plant, and the single wagon which was first made use of, a battery of tanks was built until no more room remained to accommodate additional receptacles, and there were 33 delivery wagons, besides four other vehicles. Here the first oil boats ever entering the harbor were docked, and from this station deliveries began in substantial bulk to northern towns. The Standard Oil Company came to Providence Harbor because it offered the best freight rates of any point on the New England coast. Its East Providence investment was one which was looked at with askance, but the purchase led others to see the advantages offered by a Seekonk River front, and thus came Phillipsdale.

The company is now to develop another part of the harbor front. It has purchased the Vanity Fair property, a little more than thirty-four acres in area, and the old Silver Spring property, 36 acres more. It now has a tank storage capacity of about 250,000,000 gallons, and this will be enormously increased when the Vanity Fair proposition alone is worked out. These purchases carry with them a good deal of waterfront, and the shore and shoals are to be filled in to afford a long wharf extending out to where dredges were working all last summer. The Silver Spring purchase may not be improved for some time.

When the Vanity Fair plant is completed the company will bring oil by boat direct from southern ports, unloading the product there instead of having it tanked at New York and brought by rail. This will eliminate a great volume of oil business from New York, and, as already explained, tend to make this the greatest oil distributing port on the North Atlantic seaboard. To facilitate rail distribution to northern and southern New England points numerous spur tracks will be laid from Vanity Fair. Upon the completion of this work the east shore of the harbor, from Pomham nearly up to the Wilkesbarre Pier, will be entirely devoted to the oil business. This includes the Gulf Refining company's fine and large plant along the Barrington Parkway, and the Mexican Petroleum Corporation's plant at Kettle Point. This company has a storage capacity of 252,000 barrels. Its loading racks accommodate 25 tank cars, which can be unloaded simultaneously. The 10-inch pipes at the Kettle Point station are capable of unloading the company's largest steamer, the "Edw. L. Doheny, Jr.," in about twenty-four hours. On the opposite side of the harbor is the plant of the Texas Company, a model as well as an extensive one.

Owing to the war, particularly the activities of the U-boats in the Mediterranean and the requisitions of the French government, the Fabre line steamers have postponed calls at the harbor of Providence for the time being. However, the time is not far distant when these ships and others flying foreign flags will make their way into this harbor. The Providence Chamber of Commerce is also frank in stating that it looks forward to receiving ships from the Pacific coast via the Panama Canal, including those from down the west seaboard of South America and also those from the eastern seaboard.

So Providence continues to urge the Federal authorities to take greater cognizance of that city in the matter of port calls. It presses the point because it knows that the harbor has unsurpassed facilities for reaching the interior of New England, water enough for the deepest draft ships sailing, ample anchorage and plenty of area for maneuvering.

The second State Pier at Pawtucket is rapidly approaching completion, and when this is placed in service that city will have adequate wharf facilities commensurate with its growing commerce.

The Man Who Mines Our Coal

(*Continued from page 455*)

the cars are hauled by rope or cable; in others we find locomotives of one sort or another—trolley, storage battery, gasoline, compressed air, and even steam. This, of course, spells more unevenness in cost.

In the fourth place, the distance which the coal has to be transported, both underground and on the surface, from the loading place in the mine to the point at which it is transferred to the railroad car, is of importance. In some mines this distance is but a few hundred feet; in others it is as high as 10 miles; in almost every case it increases with the age of the mine.

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The Man Who Mines Our Coal

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A fifth item of discrepancy lies in the preparation of the coal for the market. In some mines, where the coal is to be used for making steam, it is loaded into the railroad cars as it comes from the seam, under the designation "run-of-mine coal." In other operations where domestic coal is produced it has to be sized on great shaking screens. At some mines the first product is too dirty for use of any sort and has to be washed; at others it has to be hand picked to remove large pieces of slate and other non-combustibles. In the anthracite field, at most of the breakers all of the above precautions have to be employed. This part of the production of coal for the market may vary in cost from next to nothing to as high as 20 cents per ton. And while it may be the operator's misfortune to have his coal occur in combination with stuff that will not burn, it is hardly a fault for which he should be penalized by government edict.

Finally, some mines are wet and require large pumping plants to handle the water. In others the moisture will be taken care of by gravity, so that only ditches are required; while in a few there is absolute dryness and no drainage of any sort is required. In fact, some may be too dry, so that the dust in the mine has to be sprinkled periodically to prevent explosions.

It is manifestly unfair to the operators to fix a price that is to be paid for coal from every mine in the country or every mine in a given district or even two adjoining mines. A price could be set for each mine that would allow the mine a fair margin of profit; conceivably, each operator should be allowed the same profit per ton. But that each operator should sell at the same price per ton as every other is penalizing one man for the benefit of his neighbor.

What Is Coal Worth?

But even if the price of coal were to be fixed at figures determined for each mine, by considering the cost of production and the capital invested and allowing a fair profit, it would not be absolutely fair. This brings up one of the important points to be discussed and leads us to inquire "What is coal worth as a fuel?"

As all know who are familiar with the use of fuels, some coals are better heat producers than others. Some are suitable for domestic use, some for the making of gas, others are best for coking and others still are blacksmithing coals. Therefore some allowance should be made for the difference in coal quality; and this should be made on the basis of the grade of the coal and the heat that it produces. Of two coals that cost the same to mine, one may be worth 25 per cent more as a fuel than the other. The user should pay more for this better coal, because he will burn a smaller quantity of it than he would of a poorer grade. If the user pays the same price for a poor grade of coal that his competitor does for a good grade, he is discriminated against in the beginning, and in the end they will both get poor coal.

From the foregoing it can be readily seen that the price of coal should be regulated on a fair and equitable basis—fair both to the user and to the consumer. This price should depend on the cost of mining and on the quality of the coal itself. The operator is ready and willing to accept Federal regulation of his prices on this basis. In fact, in a large number of cases, the operator, if necessary, will be willing to sacrifice his profit for the benefit of the country. But he does not believe that Federal regulation of output is necessary for regulation of prices; and he does not see why he should be asked to sell at a loss because some other operator can mine coal more cheaply than he can.

It may be urged that it is unfair to the consumer to set a variety of prices for coal and leave him to make the best bargain he can with the various producers. There has never been any very audible objection to this system of producing and selling supplies in general, so we do not see why it should not apply to coal as well—especially since a regulated price for each mine would guarantee the consumer against gouging. The big and steady consumer gets the low price always; why not with coal? If there is not enough of the low-priced coal to go around, somebody must buy at the best price, and somebody else must be content to pay the next best price. There is nothing novel or startling in this; as we have suggested, it is the principle on which everything, from shoes to ships, has always been made and sold. Why not coal also?

As a matter of fact, a good many retail dealers and some manufacturers who buy their own coal do not yet see just where Federal regulation has regulated; it is almost impossible to secure any coal at the cheaper price set by the government. This is neither the fault of the Government nor that of the operator. It is due to contracts at the higher price that the operator has with wholesalers and consumers. Most of the dealers and consumers are being furnished with coal bought under these contracts, which were made previous to the regulation of the price by the Government, and have not yet expired; and the car shortage has prevented the operator from loading much coal in excess of his contract requirements—in numerous cases he has not even been able to fulfil his obligations. Now that these contracts are beginning to expire, the dealer and consumer will begin to see the effects of regulation. Some of the operators will then be confronted with the alternative of producing at a loss or closing down. Others will not be affected seriously, for although their profits may be reduced, they will not lose money by selling at the Government price. But it seems to be pretty well understood that enough coal to meet the nation's demands cannot be got out at that price.

The Fool-Proof Precision Gage

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pieces belonging to the set of blocks. These are placed against the group of blocks in such way as to form with them a kind of calipers. If there are many gages, the wear on the extension pieces may be avoided by simply using the group of blocks as a test for a caliper gage. This last is then employed in testing the plug gages for shop use. Snap gages may be set for the workmen by adjusting them with the aid of the groups of blocks. If there is too much of this work to make it advisable to use the blocks directly, they may be simply employed in the preparation of suitable master plugs and the shop snap gages set by means of them.

The rectangular blocks referred to are not an American product. They come from Sweden. The surfacing is so perfect that, when two are rubbed together and the air is excluded, a very distinct effort is necessary to pull them apart. The pulling apart probably calls for the rupture of multitudes of minute oil particles in the pores of the metal in addition to overcoming the resistance due to atmospheric pressure. Apparently, however, the piling of block on block does not affect the accuracy of the sum of the individual thicknesses. This has repeatedly been tested, although of course, there probably is some extraordinarily minute difference. It is truly wonderful to be able to pile a 1-inch, a ½-inch, and two ¼-inch blocks together, and then to have the pile prove, as far as can be verified, exactly equal to a 2-inch block. The piling must be done, however, in such way as to exclude the air. It is the possibility of maintaining the exactness of the sum that makes these blocks a practical means of testing the finest work. The United States Bureau of Standards at Washington owns a set and uses it in precision work. The processes by which these blocks are given their wonderfully perfect parallelism, flatness and accuracy seem to be unknown beyond a small circle of people.

Another precision instrument employed either directly or indirectly in such work as machine-gun manufacture is the sine bar. This is a bar of metal in which two holes have been bored five inches apart, center to center. A half-inch button is placed in each hole. If we rest each button upon a pile of precision blocks, the angle made by the bar with the horizontal may be very accurately determined; for the five

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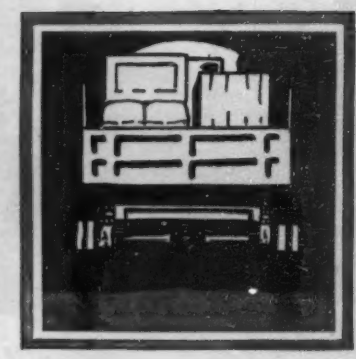
TORBENSEN INTERNAL GEAR TRUCK DRIVE

What it does

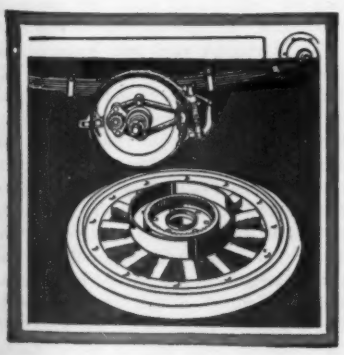
This I-Beam makes Torbensen Drive lighter and stronger than ordinary drives. It carries *all* the load. It makes Torbensen Drive last as long as any truck. It makes rear tires give 20 percent more mileage. It is *patented* and is probably the main reason for Torbensen leadership.

Torbensen Drive adds 45 percent to rear axle road clearance. Where streets or roads are torn up or muddy; when the truck has to go 'cross country; when deep snow drifts are encountered; this extra road clearance often marks the difference between a stalled truck and free, clear driving.



Here you see how Torbensen Drive works. You can see how the sturdy I-Beam passes through the wheel hub and how it supports the differential housing. This construction absolutely separates the functions of the load-carrying and driving parts, yet it holds them in practically perfect, permanent alignment.

Unusual accessibility makes it easy for any driver to keep Torbensen Drive thoroughly lubricated and finely adjusted. Torbensen Drive is exceptionally free from mechanical troubles. It is made so readily accessible to cut down the time and cost of repairs or adjustments, *should* they ever become necessary.



Simplicity is the keynote of Torbensen Internal Gear Drive. Power is applied to the wheels through internal gears *at* the wheel and *near* the rim. This gives Torbensen Drive great leverage for driving just where it is needed. It increases pulling power and saves gas and oil. These gears are guaranteed for two years—two years of faultless rear axle service.

One pound of dead-weight equals *nine* pounds of weight carried on springs, in its effect on truck life. When you figure on this basis, knowing that Torbensen Drive is *half* as heavy as other types of equal capacity, you have very strong reasons for a 20 percent increase in rear tire mileage and big savings in gasoline, oil and repairs.

THE TORBENSEN AXLE CO.
Cleveland, Ohio

Torbensen Drive is made to last. Every owner gets a Gold Bond Guarantee that the I-Beam axle and spindles will last as long as the truck and the internal gears at least two years.

Largest Builder in the World of Rear Axles for Motor Trucks

The Fool-Proof Precision Gage

(*Concluded from page 466*)

inches of the bar, and the known difference in elevation between the ends, determine a right triangle whose basal acute angle may then be found by reference to a table of sines. The sine bar may be used "going and coming"—we may employ the Swedish blocks to make the bar register a certain desired angle, which may then be perpetuated by one means or another, or we may check up a given vertical distance by measuring the angle at which it makes the sine bar set.

The fundamental feature of all these gages is the one upon which our title lays stress. It is no longer necessary to have an army of highly expert workers and inspectors to do precision work. A single skilled man, or at most a small force of such men, can set gages for many mechanics and inspectors; and these unskilled workers use the gages thus put in their hand with great rapidity and accuracy. The whole development is made possible by the idea of the non-adjustable, go-and-not-go gage. Under old systems, in order to find out whether a piece came within prescribed limits it was necessary to measure it absolutely, by careful manipulation of a gage which had first to be adjusted to fit the part exactly, and then read. Now our tests are relative, not absolute; and at the same time they are automatic. They do not tell us how big a piece is at all; they simply tell us whether it is within the permissible limits, or whether it is too large or too small.

Perhaps, the finest example of this sort of thing is to be found in a large mid-western automobile factory. Here we are not measuring a dimension at all; we are measuring the strength of springs. These must be stiff enough without being too stiff; they must give sufficiently without giving too much. The testing apparatus submits them to a definite pressure, and the tolerance is expressed by saying that under this pressure the spring must mash down at least to one given point, but not to another one. If the spring refuses to be compressed to the first point it is too stiff; if it goes past the second point it is too soft. At each point it makes a contact which closes an electric circuit and lights a lamp. Then if the white lamp flashes and the red does not the spring is O. K. but if the white light fails to flash or if the red flashes the spring is, respectively, too stiff or too soft. Nobody knows how much too stiff or too soft, and nobody cares.

There we have the thing in a nutshell. If a thing is wrong, it is wrong, and that is the end of it. We do not need to know how wrong it is, and effort spent in finding out is wasted. We do, of course, want to know how it is wrong, whether it is too big so that it can go back to the machine and be cut down to size, or whether it is too small so that it can only be scrapped and melted up again; and these things the automatic gages tell us. But if we ask them how much too big or how much too small, they will not tell us; for it is none of our business.

A Combination Lathe, Boring and Milling Machine

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tion, permitting heavy work to be done. In addition, the milling machine table acts as a support for the sliding bed when the latter is closed. The sliding lathe bed is strongly ribbed and the ways are scraped true to alinement for both carriage and tail stock. The lathe carriage is made with bridge on end towards the headstock, and extends out over the face of the apron to permit of the compound rest being used up to full swing of 25 inches for work in the gap. The headstock is made with four-step cone pulleys and is single back geared. It has a hollow spindle and the bearings are scraped to running fit. Proper means are provided for taking up wear both laterally and radially.

Turning to the milling machine, it will be noted that the table, saddle and knees are of rigid construction, scraped to accurate fits on all moving surfaces. The table is elevated on the face of the column by means of helical gears and screw, the crank for operating this member being located on the face of the column in a convenient position for the operator. The standard machine is equipped with hand feed to milling machine table.

The horizontal boring mill is of the platen and table type; the boring bar is 1½ inches in diameter and is provided with power feed, deriving its power from the lathe change gears. While the regular equipment includes countershaft, large and small face plates, steady rest, change gears, one milling machine arbor and wrenches, the following extras can also be used: power longitudinal feed to milling machine table, taper attachment, milling machine vise, and dividing head for the milling machine.

In the shop where a wide variety of work with corresponding capacity is required, the machine invented by Mr. Fleming seems to be the ideal solution. It accomplishes the work with the minimum investment, and at the same time saves the floor space and transmission which would be required for three separate machines.

Keeping Track of Our Ships in Building

THEY have a graphic way of following progress on the big 9,000-ton fabricated steel ships being built by the Merchant Shipbuilding Corporation at Bristol, Pa. These ships are to be all alike. More than 80 per cent of their plates will be sent from the steel mills ready to erect. Even the remaining plates are chiefly bow and stern parts which are to be bent at the yard shop for convenience in shipping the raw stock flat.

In the production office, therefore, are charts showing every plate on one of these fabricated ships. As soon as a keel is laid, that ship gets a chart and day by day, as plates are erected and rivted, they are marked on the chart and worked out in terms of tonnage erected on each hull weekly, and also the total percentage of each hull erected.

These figures are for office use, of course, but with so clear a method of recording progress, and with perhaps 300 riveting gangs working on 12 hulls, it would be a simple matter to translate the daily progress into some simple factor interesting to men in the yards. One way that has been suggested is to place a thermometer sign on each hull and show by means of the rising how much of that hull is completed and how it compares with all other hulls.

This yard had eight keels on the ways April 12th, and was making good progress. Its first two keels were laid February 16th, and the second pair three days later. The next four keels were laid by the old-fashioned method of hauling the plates in place by rollers and skids, for the reason that cranes on those ways were not ready.

The Merchant yard will have to drive something like 225,000 rivets weekly when it strikes its full gait. Last summer there was nothing on the site but a cast iron pipe and foundry plant, which was bought, and some of its buildings utilized in the present shipbuilding plant. The shipyard occupies 265 acres of flat land on the outskirts of Bristol, and has 3,600 feet of river front. The ways will accommodate ships up to a length of nearly 500 feet, and the company's contracts call for 40 fabricated ships of a deadweight tonnage of 9,000 each.

At Bristol, one of the first housing projects of the Emergency Fleet Corporation is being completed. The yard will need at least 4,000 men employees above those who live in Bristol or commute to Philadelphia, and therefore a complete residence town had to be provided. This town looks like a prosperous city suburb, and is situated convenient to the shipyard. It is well planned, in city blocks, with groups of bachelor clubhouses, boarding houses at the end of each block, apartment houses for small families, group houses for somewhat larger families, and, finally, detached residences for single families. All these buildings are standardized as to interior, but great attention has been paid to variety in outer architectural treatment, so that the ship workers' residence town has none of the dull uniformity which often characterizes such housing projects.

Casualties for a Big Offensive

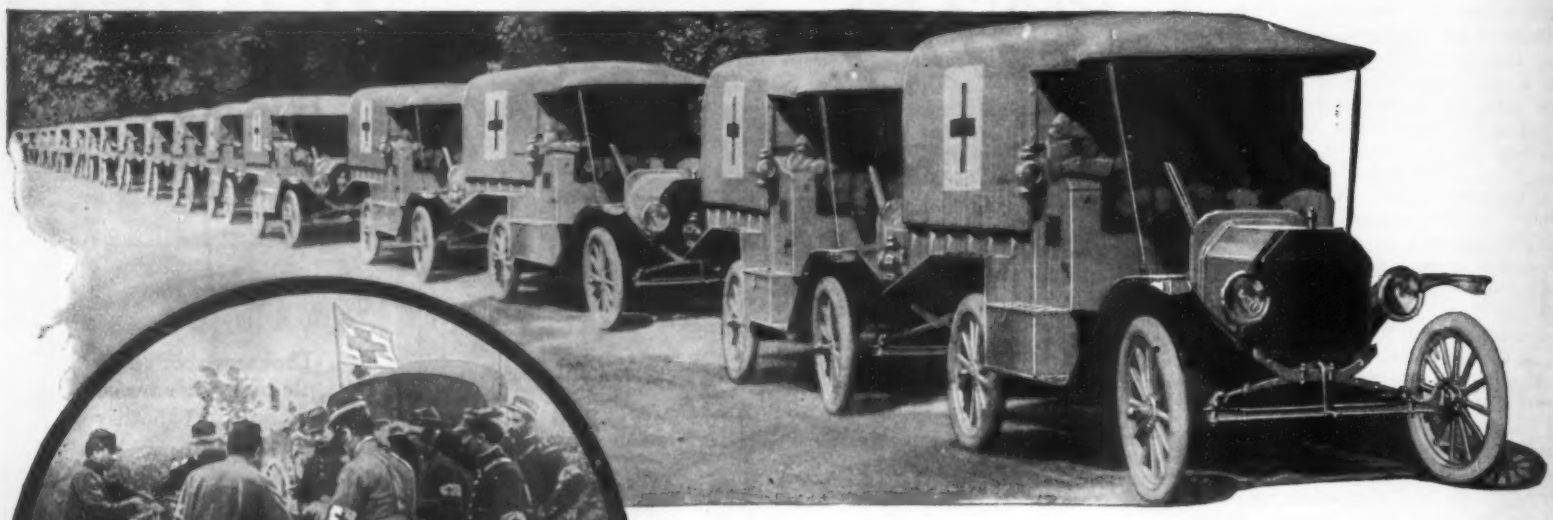
AT a recent meeting of the Académie de médecine, Dr. Tuffier, professor agrégé à la Faculté de médecine de Paris, and chirgurien des hôpitaux, read a very interesting communication on this subject. As a consulting surgeon of the armies in the field, he has been instrumental in effecting the organization of the medical services for the wounded, following the operations during the battle and confirming the ultimate results. He said that the French soldiers attained more than the assigned objective on the first day. The irresistible assault necessarily entailed a high proportion of severe wounds; in fact, although 80 per cent of the wounded were evacuated at once, 20 per cent were found to be untransportable.

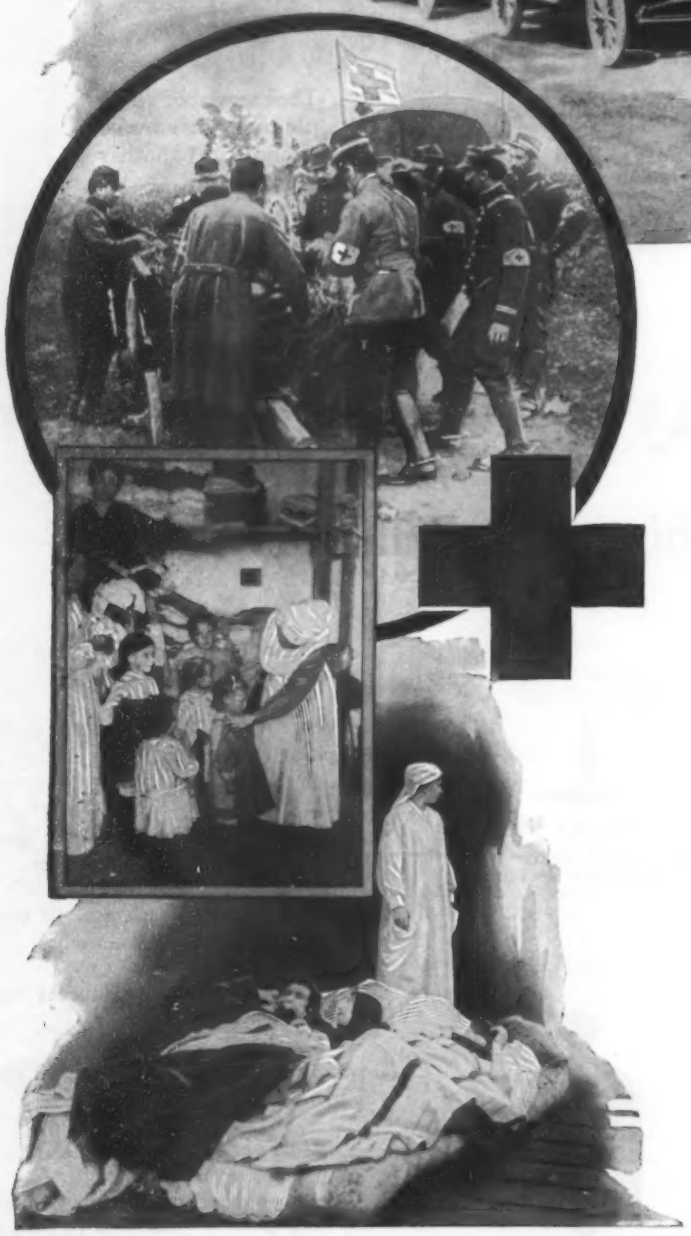
Figures on the various kinds of wounds are of interest, for this offensive was typical of big operations carried out with good artillery preparation, the best of organization and characteristic French dash. So far as the site of the wound is concerned, 16 per cent were head wounds; 33 per cent legs; 34 per cent arms; 10 per cent thorax; 4 per cent abdomen, and 2.6 per cent spine. Twenty per cent of the men suffered from multiple wounds. Shell fragments caused 72 per cent of the wounds; bullets, 17 per cent. The general mortality among the wounded has been 5.18 per cent, due to hemorrhage, to shock, and to the gravity of the wounds. Complicated gangrene had a rate of 3 per thousand, and tetanus of 5 per 10,000. The abdominal wounds were always the most severe. They caused 61 per cent of the mortality; on the other hand, wounds of the thorax yielded the greatest number of successes (20 per cent mortality). The fractures and wounds of joints comprised 77 per cent of the sutures. The wounds of the soft parts gave most remarkable results (83 per cent cured), so that after 45 days there remained in the army zone posts only 1.43 per cent of the wounded.

These results, heretofore unknown during periods of offensive of such intensity, were due to the best possible arrangement of well organized surgical posts; the rapidity of the relief given and the evacuation of the wounded to the special posts for each class of wounds, of which the need was well foreseen; the close coöperation between all the surgical services, which made use of the same technic and the fact that surgeons were able to follow their patients from the firing line back to the rear; and, finally, to the perfection of the technic of immediate disinfection of wounds, primary suture—immediate or tardy—and to secondary suture after chemical disinfection according to the Carrel method. For these data we are indebted to the *Medical News* of recent date.

Test on a Canned Food Myth

THE popular belief that canned foods will spoil and even be dangerous if left in the tin after opening has been made the subject of a technical investigation, the result of which are reported in the *American Food Journal*. Canned milk is usually kept in the tin until used up, sometimes for days, and shows no deterioration, and the result of laboratory tests demonstrated that a tin can differs little from a tin dish for keeping such foods, so far as wholesomeness is concerned. Cans of tomatoes, corn, string beans, sauerkraut, apples, pineapple, and pumpkin were opened and allowed to stand from one to three days, when the contents were examined chemically for increased acidity and the presence of tin and iron, as well as taste and odor. The increase in acidity was very slight in most cases, and the amounts of tin and iron infinitesimal, while taste and odor were in most cases normal. The investigator concludes that on general principles keeping canned foods in open tins is not good housekeeping, because the can with its jagged edge is not an attractive dish, and food emptied into another dish can be kept to better advantage in cupboard and refrigerator. So far as wholesomeness is concerned, however, keeping such foods in the cans, in which they are originally packed, after opening is not harmful in any way.





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It helps care for the orphans of the men who died that civilization might live.

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This page contributed for the Winning of the War by

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NEW BOOKS, ETC.

AVIATION CHART. Location of Airplane Power Plant Troubles Made Easy. By Lieut. Victor W. Pagé, A.S., S.C., U.S.R. Author of "Modern Gasoline Automobile," etc. New York: The Norman W. Henley Publishing Co., 1918. Price, 50 cents.

The author of "Aviation Engines" comes forward with a large chart that points out nearly all the ills that such engines are heir to, and prescribes the remedy for each. The pictorial portion of the sheet depicts a typical airplane power plant on so large a scale that every detail is distinct; where necessary, important parts and accessories such as the carburetor, magneto and spark plug are redrawn to large scale in the margin. About these central drawings, which are so carefully done as to reveal the whole construction, internal and external, of the engine, are grouped a dozen sets of tabulated instructions. The first deals with lost power and overheating, the second with noisy operation, the third with valve timing, the fourth with anti-freezing compounds, and so on through the entire list of derangements and the restoration of normal conditions. These tabulated statements give plainly the part affected, the nature of the trouble, the symptons and effects, and the means of cure. A summary of troubles is made for the benefit of the novice, who is thus enabled to locate causes of hard starting and sudden stopping. Aviators and mechanics on school and field duty will find the chart peculiarly adapted to their needs.

PRACTICAL ELECTRIC WIRING. By John M. Sharp, Instructor, Bliss Electrical School. New York and London: D. Appleton and Company, 1917. 12mo.; 266 pp.; illustrated.

This handbook offers a compendium of wiring practice as applied to bells, gas lighting, motors and telephones, with detailed instructions in joints and splices and open and concealed wiring of all kinds. The tables and data of the appendix furnish handy reference material to the wireman or contractor. From the method of distributing current by various systems to the minutiae of wiring for and installing the different fittings, the whole field is covered in an orderly and efficient manner.

BANK AND PUBLIC HOLIDAYS THROUGHOUT THE WORLD. 1918. New York: Guaranty Trust Company of New York. 8vo.; 145 pp.

No less than fifty-five public holidays are observed in our country; luckily for business most of these are localized to one or two states; yet banking and business interests the country over are affected by them, and to some extent by the public holidays of foreign countries. All these days are twice indicated in the attractive booklet of the Guaranty Trust Company, first in diary form with entries of the holidays of the world under the proper dates, and again by means of an alphabetical list of countries. The convenience of this arrangement is obvious; even minor church festivals are given, but may easily be distinguished from official holidays by the asterisk. American trade, commerce and finance and any person or organization dealing with payments or contracts, should have this compilation within arm's length.

THE STARS AND STRIPES. A History of the United States Flag. By Charles W. Stewart, Superintendent Library and Naval War Records. Boston: Boylston Publishing Company, 1915. 8vo.; 90 pp.; illustrated.

A better knowledge of the origin of the flag and what it stands for can but lead to a deeper appreciation of it as the symbol of democracy, liberty and individual opportunity. Mr. Stewart has brought together inspiring accounts of the birth and earliest use in battle of the stars and stripes, with reproductions in color of the earlier forms. He shows how its wealth of honor and glory increased under the intrepid actions of Washington, and how John Paul Jones hoisted it to a position of respect among the flags of the world; Dewey's contribution to the glorious record is not forgotten. Standard proportions for all parts of the standard national ensign are given. Notable orations and poems containing "thoughts about the flag" are quoted, and national songs and bugle calls conclude what should be a volume of inspiration to young and old.

THE BOYS' BOOK OF SUBMARINES. By A. Frederick Collins and Virgil D. Collins. New York: Frederick A. Stokes Company, 1917. 12mo.; 232 pp.; illustrated. Price, $1.35 net.

Two well-known writers of boys' books have collaborated in producing a complete account of the construction, operation and achievements of the submarine. The evolution of the submarine, how it copies the fish even to the air bladder principle, and the leagues of progress it has made since the Dutchman, Van Drebel, carried King James I along beneath the surface of the Thames, is thrillingly told. The modern submarine is described in detail, and full-page plates show the engine room, the engine, the outer world as viewed through the periscope, and many other fascinating details of equipment and operation. The boy is taught to make a working model of an underwater craft; he learns how the submarine attacks and is attacked, and the schemes for outwitting her.

COMBINED ARMY PUBLICATIONS. By Major James A. Moss, U. S. Army. Menasha, Wis.: George Banta Publishing Company, 1917. 8vo.; 835 pp.; illustrated. Price, $2.50.

There are six army publications to which frequent reference is necessary, the "Manual for Courts Martial," the "Rules of Land Warfare," the "Field Service Regulations," the "Small-Arms Firing Manual," the "Manual of Interior Guard Duty," and the "Regulations for the Uniform of the United States Army." Major Moss has performed a signal service to our military organization by combining all these in one thumb-indexed volume. Each section is fully indexed by paragraph numbers, the author having prepared a special index in the case of the "Manual for Courts Martial." Used in connection with "Questions on Combined Army Publications," published separately, a very efficient means of self-examination is provided and a mastery of the text is assured.

A BOOK OF CARNEGIE LIBRARIES. By Theodore Wesley Koch. New York: The H. W. Wilson Company, 1917. 8vo.; 240 pp.; illustrated.

This volume is a substantial and beautiful memorial to a vast, organized generosity. Ten years ago, the author made a discriminating collection of plans and illustrations of the more noteworthy Carnegie buildings; this is incorporated in the present work, and provides a useful and delightful presentation of library architecture; the debt of literature and the reading public to the ironmaster's generosity is undisputed; but the debt of architecture and town improvement is less thought of; yet these endowments have enabled towns in all sections of the country to raise buildings typical of their local genius, as the excellent plates of the volume demonstrate. There is a character sketch of the philanthropist, much concerning methods of giving and the increase of reading, and a chapter on library planning.

HEATON'S ANNUAL. The Commercial Handbook of Canada and Boards of Trade Register. 1918. Toronto: Heaton's Agency. New York: Henry Malkin. 8vo.; 490 pp. Price, $1.25.

Every year this Annual offers, revised to date, a mass of information relating to the Dominion, information that has become well-nigh indispensable to those in any way interested in our neighbor to the north, and particularly to investors, travelers, and manufacturers desirous of extending their business. It is the standard authority on customs tariff and regulations. As the compiler says, "the air is crisp with questions about Canada," and the Annual answers most of these questons; where it must fail for lack of space it refers the reader to the section "Where to Find It," which lists and describes numerous government reports and standard publications and tells how to obtain them. Immigration, finance, forests, railways, mines, towns and industrial opportunities are fully dealt with; among the new features this year we remark a section on colonization covering all provinces, and a list of pre-war imports from enemy countries. The handbook evidences conscientious collection and selection of material and remarkable accuracy; in its fourteen years of existence it has gained the merited confidence of an ever-growing army of consultants.

TRAINING AND REWARDS OF THE PHYSICIAN. By R. C. Cabot, M.D. Philadelphia and London: J. B. Lippincott Company, 1918. 8vo.; 153 pp.; illustrated. Price, $1.25 net.

Dr. Cabot is inclined to think that the physician is born rather than made; however, medicine can be learned only by practising it, and by the imitation of worthy models, and he emphasizes the ideals inculcated by the teacher as a most important factor in turning out the finished product. His work sets before the aspirant four medical types, in the hope that the young man may recognize in one of these the fruition of his own budding ambitions, so that he may have a definite goal in view. Part II discusses helps and hindrances in the doctor's development, and Part III describes the rewards that may reasonably be expected, among which, says the author, gratitude must not be looked for! As might be surmised from the standing of the writer, the reader is given the benefit of keen insight and broad outlook, and no young man who feels drawn to the medical profession can afford to neglect this enthusiastic yet conservative appraisal of opportunities, difficulties, and triumphs. The volume is a notable addition to the Training Series.

INSIGNIA OF THE U. S. ARMY. Price, 1s. 6d.

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CAVALRY STANDARDS, GUIDONS AND DRUM BANNERS OF THE BRITISH ARMY. Price, 1s.

FLAGS OF THE BRITISH EMPIRE AND NATIONAL FLAGS. Price, 1s.

OFFICIAL NAVAL AND MILITARY MEDALS AND RIBBONS. Price, 1s.

All the above are published by Gale and Polden, Ltd., 2 Amen Corner, Paternoster Row, London, E. C., England, and consist of very large folding sheets of well-executed plates portraying in a most realistic manner the various standards, medals, badges, ribbons, etc. of the British army and navy and—in one instance—of the United States Army. We in this country have been intolerant toward everything savoring of pomp and circumstance; the decorations of some of the continental European countries are at the opposite extreme and often lapse into absurdity; the English authorities seem to have steered a commendable middle course, and the results are artistic and restrained. These plates of insignia are beautifully done; they reflect great credit on the publishers—who, by-the-way, have been appointed English agents for

"Our Army and How to Know It—Our Navy and How to Know It"—and should have a wide circulation. Conspicuously posted in libraries and other public buildings, they will make an especially attractive display. We were particularly impressed with the accuracy of the "Insignia of the U. S. Army"; this is a subject that is peculiarly baffling, but a fairly close examination has failed to disclose an error in the artist's work, which is as surprising as it is gratifying. If merit and timeliness count for anything, these sheets should have a very large sale.

A MONTH IN ROME. By André Maurel. Translated by Helen Gerrard. New York: G. P. Putnam's Sons, 1916. 16mo.; 401 pp.; illustrated. Price, $1.75 net.

A month is indeed little enough to enable us to claim acquaintance with the Eternal City, but with M. Maurel as companion and guide our progress toward a sympathetic understanding is greatly hastened. Those who are familiar with his "Little Cities of Italy" know his ability so to blend history, art and description as to make the past breathe again in the treasures it has left us, while the things of today, seen against the background of that past, reveal causes and values that our own unaided eyes would be very unlikely to discover. The maps of "A Month in Rome" are particularly commendable; they are topographical sketches stripped of all unnecessary detail and thus enabled to emphasize the really significant features. As a book, this is from all points of view an excellent piece of work. It will not displace Murray or Baedeker, of course; such is not its aim or scope; but it will prove an admirable supplement to these standard guides.

THE NEW PLATOON INSTRUCTOR. Complete in Tactics and Drill as Required for France. By Capt. T. H. Gillman, C.E.F., "Canadians." Cleveland, Ohio: E. C. McKay, 1918. 12mo.; 292 pp.; illustrated. Price, $2.50.

One of the best instruction books the war has yet brought forth is Capt. Gillman's "The New Platoon Instructor," which offers in compact form the essentials of many volumes on the machine gun and its use. At the beginning of the war it took a year to turn out an expert machine gunner; now the same result is attained in three months. The concentrated methods that make this possible are fully revealed by the author, and in so gripping a manner that even the general reader may enjoy their development; for one of the aims of the book is to show "how the famous and victorious English and Canadian machine gunners have won their way to the top." The new formation of the platoon in attack is vividly presented, amazing exploits are chronicled, the lessons of the war are drawn, and the qualities and requirements of an officer are crisply outlined. The Lewis gun has a chapter to itself, and there are others on range finding, trench construction, wire entanglements, scouting and patroling, anti-gas measures, and the training and employment of bombers. The diagrams and illustrations, many of them in color, are excellent; in short, it is hard to conceive of a work better planned, or of instruction more thorough or more easily and pleasurably imparted. Its publication is permitted by the Canadian General Staff and it is recommended by the Director of Military Training.

MILITARY MAP READING AND INTELLIGENCE TRAINING. By Captain C. D. A. Barber, Late Intelligence Officer 202d "Sportsmen's" Battalion, C.E.F. Cleveland, Ohio: E. C. McKay, 1917. 12mo.; 179 pp.; illustrated. Price, $2.50.

The personnel and training of the intelligence section is vitally related to success in modern warfare; the scout, the sniper and the observer form one of the most important groups in infantry organization. Capt. Barber's well-written text enables any officer to take the map of a piece of country strange to him and to interpret correctly every line and sign; it reconciles and coördinates the teachings of numerous publications on this subject, presents a general outline of duties, and furnishes a set of notes that may be confidently followed. Its many maps and illustrations unhesitatingly point and develop the lessons of the text, and the latest methods of class instruction are given. The work includes the construction and use of instruments, and the mode of using the sniperscope and the fixed rifle stand; the principles and practice of reconnaissance and observation are helpfully set forth, and very enlightening is the German opinion of British strength and weakness as revealed in the battle of the Somme. Officers will find in this admirable work distinct aids toward the elimination of error and the strengthening of weak points in attack.

THE VIRGIN ISLANDS OF THE UNITED STATES OF AMERICA. By Luther K. Zabriskie, Formerly Vice-Consul of the United States of America at St. Thomas. New York and London: G. P. Putnam's Sons, 1918. 8vo.; 357 pp.; illustrated. Price, $4.

A clear, all-embracing account of our new possessions was greatly needed, and here we have the need filled by a highly qualified pen in an exceptional manner. Your interest in these Islands may be that of the commercial expert, or the tourist, or the historian, or simply that of the keen American, busied with matters far removed from the Caribbean; no matter into which class you may fall, this volume will hold you from start to finish. It sketches the history of St. Thomas from 1666 to the present; it paints a colorful picture of St. Croix, "The Garden of the West Indies"; it describes the bountifully watered, fertile St. John. Not content with a merely popular description of superficial aspects, the author presents many pages of solid information on imports and exports, harbor facilities and steamer service, banks and currency, the cost of living and labor conditions, sanitation, agriculture, manufacturers, population, and government. The sale negotiations between the United States and Denmark are fully dealt with, and more than a hundred illustrations from photographs, and two maps, add wonderfully to the definition and convenience of the work. We glean that there is much room for improvement and development of our new property, and it will be a fascinating occupation, a few years hence, to re-read Mr. Zabriskie's splendid volume and compare what will then be present conditions with what will then belong to the past.

THE MARVEL BOOK OF AMERICAN SHIPS. By Captain Orton P. Jackson, U.S.N., and Major Frank E. Evans, U.S.M.C. 8vo.; 398 pp.; illustrated. Price, $2.50 net.

Where is the mind that does not respond to the lure of the sea? Sea stories have always more than held their own, and here is a sea story that, told by men to whom the ocean is the breath of life, takes us into the shipyard and shows us the birth of the superdreadnought, conducts us over the finished product, and reveals the secrets of the revolving turrets and their great steel tubes. By way of contrast, we turn back the pages of Time and review the wind-driven vessels, with their billowing clouds of canvas, that won for us the supremacy of the seas. But a mere list of the good things brought to our eyes would fill a pamphlet. It must suffice to say that every type of vessel that plows upon and beneath the surface, to say nothing of those that take the air for their element, is here described, with stirring accounts of great sea fights, deep sea diving, gun firing and signaling. The twelve plates in full color are not all of equal merit; perhaps the best is that from Reuterdahl's painting in the Naval War College, showing the American fleet in the Strait of Magellan during its world cruise in 1907. This cruise is briefly but vividly depicted in the text. Hundreds of illustrations from photographs place before us our finest ships and life aboard them. Under "Fighting Ships That Fly," we see dirigibles and airplanes, Zeppelin attacks, and the "spotting" of submarines 20 feet under water. The whole work is generously planned and sumptuously executed, appealing both to the intellect and the emotions, and young and old may alike delight in it.

ANCIENT LAW. By Sir Henry James Sumner Maine, K.C.S.I. New York: E. P. Dutton and Co. 12mo.; 252 pp. Price, cloth, 60 cents net; leather, $1.25 net.

The introduction by Prof. J. H. Morgan points out that, when it was first published a half-century ago, this work immediately took rank as a classic, and he compares its epoch-making influences to that of Darwin's "Origin of Species." Maine "did nothing less than create the natural history of law," demonstrating that our social and political institutions and our legal conceptions are as much the product of historical development as biological organisms are the outcome of evolution. He thus took issue with the jurists and political philosophers of the day, and showed that the family rather than the individual first foreshadowed the Roman system of law. The relation of early ideas to modern thought is shrewdly indicated, and the early history of testamentary succession, property contract, and crime is interestingly unfolded.

THE BOOK OF THE ROTHAMSTED EXPERIMENTS. By A. D. Hall, M.A., F.R.S. Revised by E. J. Russell, D.Sc., F.R.S. New York: E.P. Dutton and Company, 1917. 8vo.; 372 pp.; illustrated. Price, $4 net.

Lawes was the first to apply sulfuric acid to mineral phosphates in the production of a "superphosphate," of which more than a million tons are now produced in Great Britain yearly; his Rothamsted farm was converted into a large experiment station, and students of agricultural chemistry well know the richness of the results as evidenced in the publications and reports that for 60 years issued from Rothamsted. Twelve years ago A. D. Hall, director of the station under the Lawes Agricultural Trust Committee, gave "The Book of Rothamsted Experiments" to the world; it was necessarily selective rather than exhaustive, but it put into logical form many of the valuable findings of Lawes and his colaborer, Gilbert. Now, with the generous aid of Doctor Russell, the present director, this work is reissued with the results and tables carried on for another decade. The aim of the work at Rothamsted has been to ascertain the conditions under which the plant derives nutriment and achieves growth, and immediately practical considerations are subordinated to this knowledge. The volume in hand is, however, addressed to the intelligent farmer as well as to the student, teacher and expert. All these men will find their respective fields illuminated in a most helpful manner.

MEMOIRS OF CARDINAL DE RETZ. With an Introduction by David Ogg. New York: E. P. Dutton and Co. 12mo.; 800 pp. Two volumes. Price, each, cloth, 60 cents; leather, $1.25 net.

"Everyman's Library" is from time to time issuing biographical works of permanent value. Cardinal de Retz had a yearning for notoriety and disregard of solid fact that militate against the acceptance of his Memoirs as an original source of reliable information, but his racy style and the life-stuff with which he deals give his work great vitality from a literary point of view. Guided by his colorful pen, the reader lives in the atmosphere of the Ancien Régime and the Fronde. Davall's translation is complete, and this compact and corrected reprint will give real pleasure to students and readers of history and biography.

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SCIENTIFIC AMERICAN

ARRIVAL OF A QUICK-LUNCH DOG AMONG FRENCH FIGHTERS ISOLATED BY AN ARTILLERY BARRAGE [See page 481]

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